ACCIDENTS

How they happen and HOW TO PREVENT THEM

Descriptions of Certain Accidents Notified to H.M. Inspectors of Factories

Published Quarterly
VOLUME 22 (NEW SERIES)
January, 1955

ISSUED BY THE FACTORY DEPARTMENT
MINISTRY OF LABOUR AND NATIONAL SERVICE

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LONDON: HER MAJESTY'S STATIONERY OFFICE



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FOREWORD

On page 13 of this issue we describe several accidents which were due to falls of earth from the sides of excavations. This type of accident is by no means uncommon and there is no doubt that deaths and serious injuries in many cases would be prevented by the provision of proper timbering, as required by the Building (Safety, Health and Welfare) Regulations, 19481. In so many cases, faults in an otherwise cohesive material are hidden and in consequence, timbering is not used. In this connection, the following extract from a recently published Code of Practice2 is of interest;---

"Except in excavation inside sloping banks, rock, or within caissons, all excavations should be lined with poling boards, runners, or sheet piles supported laterally by framings of walings and struts, which may be of timber, steel, or reinforced concrete, to a sufficient extent to prevent excavation from becoming dangerous to life or limb by movement or caving in of the adjoining soil ".

Death from Electric Shock

An interesting article3 in a recent issue of the Electrical Review deals with apparent death from electric shock and stresses the need to begin artificial respiration on the victim immediately. The author says " it would be most unwise to waste time trying to find out whether the victim of electric shock has stopped breathing, or has no pulse, and thus it is better to accept anything which looks like unconsciousness as the real thing and get to work at once ". He quotes a continental authority as saving that there is a 95 per cent. chance of success if artificial respiration can be started within one minute of the accident. The author reviews the various methods of resuscitation and gives a useful bibliography.

The latest reports on electrical accidents published by the Factory Department says that in 1952 there were recorded 16 cases of successful restoration of consciousness by artificial respiration and 21 unsuccessful cases. successful cases, about half were revived within ten minutes. Statistics taken for a number of years record frequent cases of recovery after one hour's application with more exceptional instances of success after two, or even three, hours of persistent effort.

Training of Young Persons

The Dangerous Machines (Training of Young Persons) Order, 1938 has been revoked and a new Order5 has been made in its place. The effect of the new Order is to increase the number of machines scheduled as being of such a dangerous character to bring them within the scope of Section 21(1) of the Factories Act, 1937. A young person may not work at any machine included in the Schedule to the Order unless he has been fully instructed as to the dangers arising in connection with the machine and the precautions to be observed, and (a) has received a sufficient training in work at the machine; or (b) is under adequate supervision by a person who has a thorough knowledge and experience of

the machine.

S. I.1948 No. 146—H.M. Stationery Office, price 1s. 3d.
"Civil Engineering Code of Practice No. 4 (1954)—Foundations", page 126. The Institution of Civil Engineers, 1, Great George Street, London, S.W.I., price 15/-.
"Apparent Death from Electric Shock." H. W. Swann, O. B.E., D. F.H., M.I.E. E., formerly H.M. Senior Electrical Inspector of Factories.—Electrical Review, 14th May, 1954, page 879.

Electrical Accidents and their Causes, 1952-Factory Department Form 929-H.M. Stationery Office, price 3s. 0d, S.I. 1954 No. 921—H.M. Stationery Office, price 2d.

INDUSTRIAL ACCIDENTS

VOLUME 22 (NEW SERIES)

The description of accidents and accompanying illustrations or diagrams in his publication are intended only for future guidance in safety matters and not to convey implications as to the extent, if any, to minch particular individuals or firms may have been to blame in connection with the accidents in quantion.

Gassing

"SURPRISE" GASES

Many examples could be quoted of the use in industry of materials which cause no risk of gassings as long as they are kept separate from one another, but which nevertheless give off a toxic gas when brought into contact with each other. In the case of the contact which can be contact with each other. In the case of the contact with the contact

The first accident occurred in the blanch department of a dyeworks. Sodium typochlorize solution and sulphuric acid were stored separately in two tanks below the blench house floor; each tank had a small centrifugal pump for pumping the fleight of the processing tanks on the floor shows the processing tanks on the floor shows the processing tanks of the floor was noticed that the "loose" pulley not the acid pump was driving the said pump was flowed that the "loose" pulley had tightened no in bearing, and an attempt was made by a fitter to free the pulley. Meanwhile said was continuing to enter the process much and causing clothene to be floriested from the hypochlorite. The fitter such and causing clothened to be floriested from the hypochlorite. The fitter incore" pulley no half bearing the gray for clothing the cause of the pulley on half bearing the gray for clothing the sudd and hypochlorite pipes when not in use.

The second accident occurred in a works where acetate film is processed in very dilute solution of sodium hypochlorite and sulphuric acid; the solution is so dilute that such chlorine as is normally liberated is adequately dealt with by an extraction fin. A worker was trying to dean the silice covered immersion beater for the process tank, and mixed for the purpose unsilited sodium that the contract of the purpose unsilited sodium that the contract of the process tank, and mixed for the purpose unsilited sodium that the contract of the contract of

The next case also concerned a dysworks. Both sodium hypochlorite and secretic said rue used in the dysbounce, and en stored in endropes. Normally, care is taken to keep the hypochlorite in one room and the aceticacid in another. However, on this principal rad, the cathops of Propochlorite had all been moved to another position as repairs were necessary to the floor of the room in which the carbops were normally kept. During the removal, a carbop of acetic additionable mixed up with those of hypochlorite. A labourer needing more hypochlorite in his proposition of the propositi

The last of the four accidents occurred in the hleach croft of a textile printworks. A mixing tank was used for preparing hleach flayor, and for diluting hydrochloric acid. Between these two operations, the tank should be thoroughly washed out. It was on one occasion not properly cleaned of bleach flayor, and when acid was next admitted to the tank, chlorine fumes were evolved. A boy was gassed, and was in consequence absent from work for a week.

Hydrogen cyanide (prussic acid) generated unecportedly has been responsible for a number of accidence. No electricide in Volume 15, Item 13, of this Series occurred at a plating works where solid synainde was wrougly added to a build be solid to be solid to

Sulphuretted hydrogen is another gas that is liable to be released and catch workproples names. Because of its smell of rotton eggs, it has always hene reparted as somewhat of a joke, but it is for two reasons a particularly dangerous gas. It is almost as toxic as hydrogen symide, having a powerful aphysicalized effect, yet in high concentrations its presence can pass unnoticed, for it may paralyse the sense of smell. The worst candent on record occurred own years ago at a innery. It was the practice to run into one settling tank all the Periodically, the top jusque was sphoned off, and the ships, so we reform the practice of the property of the

strata or pockets, some acid, some alkaline. When the ludge was disturbed, and pockets would come into contact with pockets of lakaline subjudie and generate subphurelted hydrogen. More recently, at a gasworks, two men were was alkaline from all other tources of the subject of the property of the subject of the subject

Besides affording examples of the release of a "surprise" gas, these last two accidents illustrate well the danger that should above be associated with sludge. If sludge cannot be removed from a vessel or pit from outside, and men haven to go inside to perform the job, they should aboves be protected by breathing apparatus of the oxygen, compressed air, or air-line types. Canister respirators should never be relied upon for entry into a vessel.

Brick and Tile Works

2. FLYING FLOOR BURNS MAN

A furnace was recently installed in a brick and tile works for the purpose of dyring sand. At the end of this process the sand, which had reached a temperature of 100°C. was discharged on to a concrete floor. A heap of sand cools very slowly and so a man spread out the sand with a showel. As he did so parts of the floor which had been heated by the sand came into contact with the much cooler air and the concrete disintegrated, the man being slightly burned by flying pieces. The floor had been heated to such an extent that an area some 2 for source sould lot a deep the day of the sand source sould to a deep the about 50 miles of the sand source sould to a deep the about 50 miles for inches.

Floor which are to be heated by quantities of material at 1000°C, or by any other method which will produce temperatures of this order, should be specially prepared, as they are being used in conditions which approximate to those imposed on a furnace wall. If concrete is used, the only suitable material is refractory concrete which is designed to withstand the thermal shock associated with heating and cooling through a wide range of temperatures.

Printing Machinery

3. TRAPPING AT LETTERPRESS PRINTING MACHINES

On some two-revolution, flat bed, letterpress printing machines there is a serious risk of trapping under the feed-board where the forme bed runs out to meet the frame of the machine. Two recent accidents at this point draw

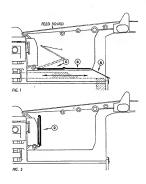
head was caught in the trap. It is not known why he was in the position in which he was found, but it is thought that he was reaching for something inside the frame of the machine. In the second case a machine minder was reaching for an oil can which was standing at the end of the machine frame when he trapped and severely injured by the outrunning forme bed, as shown in illustration below. The page in the frame is clearly shown in the inset at A.

Access to this trapping point should be prevented when the machine is in motion. One way of doing this is by the fitting of an interlocked guard such as that shown in the drawings opposite. In Fig. 1 the guard is shown in the



closed position, enclosing the path of travel of the bed. It consists of two mental plates A and 8 langed to the wooden board Con which the minder kneeds to "patch-up" the cylinder. The hinges are so arranged that the two outer mental plates can be folded, as shown dotted in Fig. 1, to lie on the wooden board. Fig. 2 shows at Dot whole pand raised to that it lies also to the board. Fig. 2 shows at Dot whole pand raised to that it lies also to the manufacture is topped as 500 as a top and of the pand is raised, and the pand must be in the fully closed position before the machine can be at it medion. This two of fexauf a fixed to pow machines and is available for existing machine.

Another method of preventing access to this dangerous trap is by providing fixed guards at the sides of the machine under the feed board and an interlocked "rise and fall" screen at the end of the machine.



Laundries

A BURST OF HYDRO-EXTRACTOR BASKET

One man was killed and two others seriously injured when the basket of a hydro-extractor burst in a chemical works, completely wrecking the machine. The cutractor was of standard type having a basket of mild steed 48 ins. diameter. The cutractor was of standard type having a basket of mild steed 48 ins. diameter copper gause and twill cloth for filtration purposes. The material being handled was pumped direct into the rotating basket in the form of a sturry by means of a facility ble note ten of of which was held by the operator, who shut of the basket occurred immediately on completion of loading and previously for the basket occurred immediately on completion of loading and previously there had been no noticeable abnormality in the machine's behaviour. Fortunately the outer stationary casing (monitor easing) was of mild steel of continuous control of the basket occurred immediately on completion of loading and previously the outer stationary casing (monitor easing) was of mild steel of the accident were less serious than would otherwise have been the case.

The machine was manufactured only five years previously and had changed hands after it had been in use for two years. Investigation of the accidint revealed that the basket wall was in an advanced state of corrosion no doubt due to the activity of the sturry. The photographs opposite show a piece of the actual basket compared with a sample of sound plate drilled with perforations of the same diameter and pitch as the original basket. The view of a section through the plate shows how the corrosion had caused deep fissures in the metal between the perforations.

Failure of the basket was attributable to the fact that the metal had been caten away to such an extent that the basket was incapable of withstanding the high stresses due to its rotation under load. The action of corrosion is insidious; given favourable conditions it progresses continuously and unobstrasiely and it requires an experienced person to assess accurately its effect on the strength of a machine.

Since this type of accident occurs from time to time, the following precautions should be taken.

- 1. The machine should be thoroughly examined by a competent person at regular intervals, particular statetion being paid to the condition of the basket. The actual interval between the examinations should be specified by the competent person who will take into account the condition of the distribution of the condition of the
- After any alteration or repair to a machine, and also after a new basket has been fitted, the machine should not be put into use until it bas been certified by a competent person to be of adequate strength and suitable for the duty required.
 - Every second band extractor should be examined and reported upon by a competent person before being taken into use for the first time.
 - 4. No extractor should be used for a purpose for which it has not been designed unless the competent person certifies that it is safe to do so and, preferably, only after the maker has been consulted.
- 5. When a new machine is being ordered or the basket of an existing machine renewed, the makers's bould be informed of the nature of the material to be bandled and, if it is corrosive, a basket made of metal resistant to corrosion is desirable. Apart from increased safety such a basket will have an apprecial byly longer life. Baskets lined with vulcanite are also obtainable.
- Each machine should be fitted with a plate clearly marked with the following particulars:—
- Machine identification number or symbol (if the maker's number is known this should preferably be used). Name of maker.

Date of manufacture

Maximum safe working speed of the basket.

Maximum safe working load.

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Specification of material from which the basket is made.

This plate should be fitted in a prominent position and where it will not be affected by corrosion.

- The basket of an extractor should not be permitted to run at a speed greater than the maximum safe working speed.
- 8. No extractor should be permitted to earry a load greater than the safe working load of the basket. When the load is in fluid form the method of feeding is important because the rate of extraction or separation of the liquid diminishes as the thickness of the deposited solid material increases. A build-up of the "mother-liquid" may be highly dangerous, particularly on a madeine of designate for dealing with fluids ince, part from consideration of overhood, the basket may start to oscillate and unless the be fed under careful control perficulty by on that the rate of fed of "sale-off" towards the end of loading. Instead of relying upon the judgment of the operator to assess the load, it is an advantage to fill the extractor from an overbead tank containing just sufficient material to load the machine to capacity.
- 9. Many old machines have cast iron easings and these are liable to shatter under the impact of a bursting basket (see Item 11 of Vol. 4 of this Scries). If possible the casing should be suitably reinforced. A substantial brick wall or mild steel plating will minimise risk to personnel under such circumstances.

Building and Constructional Work

5. HANDLING OF BUILDERS' PLANT

Several accidents have occurred during the transporting and handling of builders' plant, particularly concrete mixers, emphasising the dangers of using makeshift tackle for this work.

A firm of plant hirers bad no suitable vehicle immediately available to move a concrete mixer from one site to another and the prospective user obtained an ordinary open high-loading lorry from a transport company. The driver, assisted by three other men, attempted to load the mixer on to the lorry by using two 11 ft. x 9 ins. x 2+ ins. badly worn planks as a ramp to the tailboard, which was 4 ft. 2 ins. above ground level. Bricks were stacked beneath the planks at mid length to provide additional support. A rope was secured to the front axle of the mixer and with one man pulling from the lorry, the other three men took stations behind the mixer and began to push it up the ramp. The mixer was half full of hardened concrete and during the frequent rests which were necessary the wheels were scotched with bricks. When the front wheels of the mixer reached the level of the lorry floor the mixer suddenly toppled over to the right and fell on one of the men, who sustained fatal injuries. It appeared that at the moment when the front wheels were being manipulated on to the lorry one of the boards forming the ramp either slipped or was accidentally moved by one of the men pushing the mixer. (See illustration opposite). A similar accident, although with less serious consequences, occurred while underlined in a mixer also from a high loading lorry. In this case one of the mixer wheels ran of five edge of one of the plants used as a ramp and the injured person, who was guiding the mixer during its descent, was prevented from jumping clear by accumulations of serap material on the ground.

In handling mixers and other heavy items of plant, it is essential that proper equipment be used if accidents are to be avoided. Minimum requirements are a winch or tackle to give a steady, controlled pull or regulated descent, and properly supported ramp beards of adequate strength, provided with fixing hooks or other devices to prevent slipping, and having adequate bevels to lead on and off the ramps.

6. HAZARDS OF MOTOR DRIVEN PLANT VEHICLES

Motor driven plant vehicles present a growing hazard on building sites, and the two accidents referred to below are typical of those which increased mechanisation of building operations has brought in its train.

In the first instance a small dumper was being used to carry and tip hard core into a foundation treach of appreciable width. The driver approached the treach in reverse and, although moving very slowly, he misjudged the approach; the rear wheels of the dumper overshot the oldge of the treach and the vehicle toppled over. The driver was thrown from the driving seat to the bottom of the trench, the dumper falling on top of him and causing fattal injuries.

The provision of stops or checks laid along the edge of the trench would have avoided the risks attendant upon faulty indgement of distance by the driver, who had twice previously driven into shallow trenches on the same site. It is good practice to fleave at lesst an occasional poling board projecting above the surface of the ground to act as supports for sleepers laid alongside the trench and form a barirer against which vehicles can back to be justed in the trench. Similarly such poling boards enable the requisite protection to be provided to prevent persons falling into doep excavations.

In driving dumpers and similar vehicles to the edge of excavations the risk of collapse of the sides of the executation due to the increased loading should not be overlooked, and the provision of extra timbering or shoring may be necessary to comply with regulation 78(2) of the Building (Safety, Health and Welfarz Regulations, 1948.* (See Item 7 of this issue and illustration on zees 14).

The second case involved a bulldozer which was being used to clear a building sit. During the operations the driver had cause to leave the cabin and before doing so he switched off the engine and engaged reverse gear. As he climbed out of the driving eath his knee struck the starter button on the dashboard and the engine fired. Before he could bring it under control the bulldozer backed against a felled tree, trapping a labourer and inflictings serious leg injuries.

Arrangements have now been made to move the starter to a position beneath the dashboard and to convert it from a "push" to a "pull" type control. The dangers from inadvertent contact with starter buttons have been stressed frequently and, while re-siting is a useful precaution, the provision of a shroud to prevent accidental operation is the most effective sufguard.

^{*}S I 1948 No. 1145

7. COLLAPSES OF EXCAVATIONS

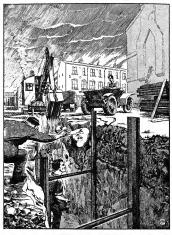
Accidents due to sudden falls of earth from the sides of excavations or trenches have been described in previous Volumes of this Series and illustrations of methods which should be used to prevent such collapses have been shown, but in spite of the publicity given serious accidents continue to occur.

In a recent case a trench about 16 ft. deep and 2 ft. 6 ins, wide was being dug for a small sewer through graved and clay soil. The sides of the trench appeared (as is usual) to be firm and stable but, a few days after the trench happeared (as is usual) to be firm and stable but, a few days after the trench which go in the bottom of the trench was killed. Occasional vertical timbers had been used as supports for the trench sides, but these were quite inadequate to prevent a flat of earth and the general foreman stated that he did not really consider the service of the s

In another case, three parallel trenches, each 150 ft. long by 4 ft. wide by 10 ft. 6 ins. deep and at 12 ft. centres, joined by cross trenches of similar width and depth, were being dug by a mechanical excavator in preparation for the foundations of a block of flats. The site had previously been built upon and for the first 4 ft, of depth the ground consisted of loose soil, old brick foundations, lengths of 4 ins, and 6 ins, diameter drain pipes and general rubbish. Below this made-up ground there was a 4 ft, to 6ft, stratum of brown clay and below that gravel or ballast. Trenches dug in this type of soil are particularly liable to collapse without warning, for the top layer of made-up ground is too variable to have any cohesion and the clay layer below is quickly affected by changes in the weather or by the amount of water which may drain through from the surface. Some support had been provided for the sides of the trenches by the provision of 14 ins. wide, light section, steel piles, or trench sbeets, but these were placed at 8 ft. centres which left a 7 ft. unsupported length of trench wall. The trench sheets were strutted by single adjustable steel props placed some 4 ft, from the top of the trench. This "timbering" was usually erected after the concreting of the bottom of the trench bad been completed.

In a third case, a trench about 12 ft. deep by 3 ft. wide had been dug alongside the wall of an existing building, in order to build new foundations of the wall at a greater depth; no timbering was used because the soil appeared to be compact dry clay. It should, however, have been realised that the ground must have been disturbed when the wall was built and that the pressure from the carried of the control of the control

A labourer was seriously injured by a large fall of earth from the side of the trench while he was spreading concrete for the footings (see illustration overleaf). At the time he was working several feet beyond the protection afforded by the last pair of sheets although, especially in view of the nature of



the ground, the execusive distance between detects and the use of single propmatch the protection of very doubtful value. These these could not be regarded as other than a very temporary support placed in position as soon as the excesstor bucket had faished degings at the particular spot. Such temporary supports should have been creeted long before concreting took place, and before which they should have been repeted by proper timbering. Factors which increased the liability of this trench to collapse were the tracks of the mechanical increased the liability of this trench to collapse were the tracks of the mechanical an enchanical barrow at the older.

In yet another case, the excavation was for the basement of a new building extending over an area measuring 80 ft. by 30 ft. to a depth of 11 ft. The material was compact clay and the builder decided to provide some sort of support for the sheer sides rather than cut them back to the angle of repose of the soil, although the site was large enough for this to be done. Unfortunately, the support provided was neither strong enough nor was it placed in position as early as possible in the course of the work and, whilst men were engaged in fixing the supports, a heavy fall of earth occurred causing the timbering in course of erection to be pushed over, and inflicting serious injuries on several of the men. In this case vertical timber boarding was held in position by horizontal walings, and these in turn depended for support on vertical steel scaffold tubes driven about 18 ins, into the ground in the bottom of the excavation. These vertical poles were afterwards to be strutted with other scaffold poles bearing against stakes driven into the ground. The whole arrangement lacked stiffness and solidity and it is not surprising that collapse occurred. The tendency to collanse was aggravated in this case by piling building materials close to the edge of the excavation, although the site was large enough to allow safe stacking elsewhere.

In all the above mentioned cases the provision of proper timbering for the excavations, as was illustrated in Volume 13, Item 14, of this Series, would have prevented the accidents, and the death or serious injury of a number of men would have been avoided. Part IV of the Building (Safety, Health and Welfare) Regulations 1948* deals with precautions to ensure the safety of excavations.

The last accident in this group is somewhat different to those described. During excavation work on the site of a building operation it was necessary to cut away part of a 10 ins. thick concrete floor slab. Instead of demolishing the slab before excavation was commenced below it, the earth was dug away from beneath the slab until there was an unsupported overhang measuring some 3 ft. x 4 ft. While a labourer was still digging beneath it, the slab broke off along the line of the supporting earth and fell on the man causing severe injuries. The slab was not reinforced. Any unreinforced concrete which is allowed to overbang much more than its own thickness is liable to break under its own weight, even though the stress may amount to only a few pounds. In this case a conservative estimate of the weight of the overhanging portion of the slab was 600 lbs. The danger which this accident illustrates is dealt with by Regulation 76 of the Building Regulations which requires that where an excavation is likely to reduce the security or stability of any part of a structure to a dangerous degree, adequate steps must be taken before and during the progress of the work to prevent danger to any person employed.

8. COLLAPSE OF A BRICK WALL

During the erection of a eavity wall 11 ins. thick and about 33 ft. long x brilfs (ins. high, which formed one side of a church building, stormy well developed and in a gusty period the wall collapsed, burying and lilling one of the brucklayers. This wall was constructed in accordance with the architect's design without buttresses or piers, and no lateral support was afforded by the ascribing the construction of the roof from which the wall well exertified in the construction of the roof from which the wall eventually derive stability to resist wind pressure. The workmanship was good and when the collapse cocurred the morats had had time to set.

^{*}S.L 1948 No. 1145.

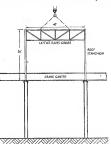
A short time after this collapse, the corresponding wall on the opposite side of the building was also blown over, but fortunately this time no injuries were caused although the material damage was considerable. After these unfortunate occurrences the design of the walls was modified to include reinforcing piers.

Large areas of brickwork in walls and in chimney stacks often depend for their stability on other parts of the building and, until the latter are in position, temporary supports should be provided for the brickwork.

Regulation 94(1) of the Building Regulations, 1948,* requires precautions to be taken to prevent danger from the collapse of any structure during any temporary state of weakness or instability.

9. COLLAPSE OF STRUCTURAL STEELWORK

The structural steelwork forming part of a new factory building was in course of crection when two of the standards above the crane gantry level of crection when two of the standards above the crane gantry level for supporting the roof trusses, collapsed while the lattice eaves girder was being placed in position with the said of a scotch derrick crace keep diagram). Two crectors who were at the top of one standards not bolt the eaves girder in monition were failured.



The stanchions, which were about 36 ft. long and weighed 3 tons, were connected to the crane gantry columns by a joint which was designed to allow flexibility parallel with the length of the building. The joint was therefore

^{*}S.I. 1948 No. 1145.

only capable of withstanding a small overturning moment, and the roof staders choice consequently had fillet stability in that direction until the caves gives were fixed in position between them. They were not temporarily stayed or supported in any way. The lattice eaves girder was 40°L tong and weighed about 1½ tons. It was being handers and the stability of the stability the stability of the

It should have been clear that the special design of joint between the crane columns and roof stanchlors required precautions to be taken during creeding in order to avoid overstressing, and this could easily have been done by view rope guys. Guys would also have provided the means for moving the stanchions sufficiently whilst accommodating the eaves griefre between the webs.

The framework of many buildings, whether of steel or reinforced concrete, elepted for stability on bracing between the members. Sometimes this depends on completion of the cladding, e.g., the walls, of the building. Precautions should always be taken to guard appairst collapse whilst any such temporary state of weakness exists. Regulation 34 of the building doctry, Health and which should be taken.

10. FATAL ACCIDENT TO STEEL ERECTOR

A worker was killed recently when engaged in the erection of a multi-floor steel framed building. The stanchions were 40 ft. high and most of the floor joists had been cretted at that level.

The steel erectors were sitting astride joins already bolted in position, there being no platforms or ladders of any kind provided at this level, whilst a crane lithed up to them one of the secondary beams 10 feet long, by means of a single chain sling passed round the centre of the joist. Clears were riverted to each side of the web at both ends of the beam for bolting it to the main joist already each of the webstrap in the similar plots already each of the webstrap laded a night below through one clear at either end of the beam. One of them then moved along the beam to release the sling. Apart from the inadequacy of a single bolt at each end, the botts were, unfortunately, both on the same side of the web and this excentric flastening meant that the beam would tend to prive tround the two bolts as soon as the sling was released. This danger was not appreciated and, as soon as the erector had unbrooked the remaining the sling that the property of the sline of the sline of the sline of the sline. The first 90 ft, to the remain. (See litheration overlead).

The immediate cause of this accident was the human error in placing both bolts on the same side of the web, a circumstance which would have been avoided if two bolts at least had been fitted at each end, but apart from this, ordinary safe practices had not been observed. These include the provision of ladders

^{*}S.I. 1948 No. 1145,



Fatal Accident to Steel Erector (see page 17).

and temporary platforms for bolting up, both of which can be fitted to the stanchion on the ground hefore exerction. Regulation of orthe Building (Safety, Health and Welfare) Regulations* requires that suitable scaffolds and after means of access hall he provided when work cannot safely be done from the huilding itself, and the provision of such ladders and temporary platforms should considerably reduce the risks which the exercition of structural seek work entails. The use of a two legged sling instead of a single chain for litting upproses is advantageous for several obvious reasons. For example, in the case described, it would not have been necessary for the erector to climb along the heam to unhook the sling.

Explosions

11. GAS MAIN NOT EFFECTIVELY ISOLATED

In the tempering shop of a stoelworks, a dissued overhead gas main, 30 inches in diameter, an the length of the shop; it was a branch from a main in use, and had been blocked off by building a brick dam 18 inches thick near the junction with the "live" main. To help in the evailation of the dissued main, a few of the 12 inch streakir inspection bole covers, appead at intervals of about to the contraction of the dissued main, a few of the 12 inch streakir inspection bole covers, appead at intervals of about to rest over the innecetion holes but were not secured.

Certain of the furnaces were heing reconstructed by a firm of outside conractors, one of whose men was using an oxy-acceptione torch in a position a few feet from one of the open inspection holes on the old gas main. Evidently aga was leaking past the brick dam and escaping from the inspection hole, for it ignited at the torch and there was a mild explosion in the main. A loose inspection cover was dislodged and fell on to a lahourer nearby.

This occurrence illustrates the unreliability of a single brick wall as a dam or stopper in a gas main. Here, gas lasked past although the vall was 18 inches thick and the gas was crude producer gas yielding heavy deposits. Experience has shown that where brick walls are used for the purposes of isolation, they should be in duplicate; each wall should be at least 9 inches as a least 1 with the contraction of the contraction of

12. EXPLOSION FROM A HOT WATER TANK

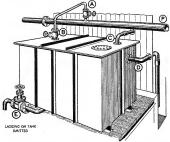
A workman was killed and three others suffered from shock as a result of an explosion from a large hot water tank which had stood idle for some three months and which when it was taken out of service had heen presumed to contain only a small amount of water.

The tank had heen supplied from a horehole with water rich in mineral salts and was heated by the injection of live steam from the main piping P, admission heing controlled hy the stop valves A and B. (See illustration overleaf.) In order to ensure that there would he no huild up of pressure during the ordinary course of working, a vent pipe C was provided to conduct air and steam to the open air.

^{*}S.L. 1948 No. 1145.

through an aperture in the wall, while an overflow pipe D was fitted near the top of the tank and led to a gutter outside the building.

It would appear that at the time the use of tank was discontinued only the stop valve B was closed, and a thorough examination of this valve following the explosion revealed deep scores on the faces.



There is no doubt that while the tank was not in use appreciable quantities of steam entered owing to poor seating of the stop valve B. The boiling of the water as a result of the heat produced, disturbed the shall formed from the impurities in the water sad, when the condensate reached the level of the overwhen the condensate that the state of the produced of the condensate the state of the produced of the condensate that the state is the state in the state in the state is the state in the state is the state in the state in the state is the state in the state in the state is the state in the state in the state is the state in the state in the state is the state in the state in the state is the state in the state in the state in the state is the state in the state in the state in the state is the state in the state in the state in the state is the state in the state in the state is the state in the state in the state in the state is the state in the state in the state in the state is the state in the sta

For a few days before the explosion the weather had been extremely cold and the partially blocked overflow pipe was finally sealed by the formation of ice in the part exposed to the cold air on the outside of the building.

As the drain valve E at the bottom was shut, the tank was now a closed vented without any relief facilities, and a pressure built up from the steam passing the deflective stop valve an explosion of considerable violence occurred, it is of interest to note that out of several similar stanks at this factory, the wrecked vessel was the only one on which the manhole cover was bolted down. Had the cover been loose it is probled that nothing now than its dislogement Step have been taken to prevent a recurrence by locuting the manhole covers by pag and leaving them free to relieve pressure, by regular cleaning and inspection of all parts of the apparatus, by reducing the steam pressure from 100 to 25 pounds per square inch, and by treating the water supplied to the tanks. In addition the vent pipe will be shortened and the overflow pipe lagged and arranged to discharge where there is no risk of freezing. Finally, and not least important, care will be taken to ensure by regular examination and maintenance that all walves are kept in a proper state of repair.

13. EXPLOSION OF A CARBIDE FLARE

A labourer attempted to light a carbide flare (that is, a small portable acetylene generator) during night work at a building site, but found that the jet was choked so he unscrewed the jet and attempted to use the flare without it by applying a light to the aperture from which be had unscrewed the jet. The flare exploded and blew off the top joints of the index and middle fingers of the man's left band.

The aperture was so large compared with the size of the jet that a blow-back was almost inevitable, and yet the same man had used the flare successfully without the jet only a few days before.

It is most unwise to use any acetylene apparatus in a way orber than that for which it has been designed, unless the makers of the apparatus bave been consulted and have sanctioned the change. The supervision of labour on this site must bave been poor whereby this man was able to perform the same abviously danaerous action twice within the space of a few days.

Abrasive Wheels

14. BURST ABRASIVE WHEEL

Every year numbers of accidents which are severe and often fatal are caused by the over-specifing and subsequent bursts of abrasive wheels. It cannot be reiterated too often that abrasive wheels should be operated at the speed recommended by the makers and in no circumstances should that speed be exceeded.

As a wheel wears its surface speed will decrease, whereas in the interests of production efficiency it is often destrible to maintain a constant periods speed. To compensate for the diminishing size of wearing wheels, some machine are fitted with stepped pulleys so that the spindle speed can be appropriately increased and an efficient peripheral speed maintained. In such cases, however, an interlocking device should always be provided which will prevent the operator, either through ignorance or misplaced zeal, from stepping up the spindle speed in excess of the safe peripheral speed. Dassed on the actional wheel diameter.

Certain modern machines are provided with introlocing arrangement to prevent overspeciality consequent on the wheel wearing down. In one and machine the interlocking is achieved by a gate which controls the movement of the bott over the steps of the pulley, in sascistion with the movement of the work rest. The arrangement is such that the best cannot be shifted on to a higher speed step unless the work rest is advanced towards the wheel. As the work rest cannot, of course, be moved inwards until the wheel wears. Like work rest cannot, of course, be moved inwards until the wheel wears. Like the control of the work rest cannot, of course, be moved inwards until the wheel wears. It is not be considered steps. It is classed with the peripheral speed which the machine allows.

In a works where such a machine was in use it was necessary in the course of the work to grid long castings, and when it was fround that the work to shampered the work, the rest was removed. After a time it was decided to make up for any loss of griding efficiency by increasing the speed of the wheel. The machine was stopped and the workman making the adjustment moved the loft from the lowest right up to the highest speed step. This was possible only because of the absence of the worker. When the machine was started up the wheel burst and inflicted fatal injuries on the operator.

There are alternative interlocking arrangements which do not depend upon the presence of a work rest and these are available for many makes of machine. If such an alternative interlock had been used, this accident would not have occurred.

Electricity

SUDDEN REVERSAL OF MACHINE INJURES CLEANER

An accident occurred at a 10-roll independent paper calender. The rolls were in the vertical plane, the third from the bottom being driven by a variable-speed D.C. shunt montor with interpoles. Control of the motor was of the Ward-Leonard type. There were two rolls below the driven roll and seven rolls above, and nine of these were of the tilling type.

The machine had been used up to midday on Saturday. On attempting to start up at midingith on the Sunday, the motor would not run and the includence of the start up at midingith on the Sunday, the motor would not run and the includence restor at that time, the electrician was able to seat rup the motor on slow speed, meabing the calenderman for the start up the motor on slow speed, meabing the calenderman for the rule of the start up the start

Suddenly an unusual noise came from the motor; and the calenderman was found to have been injured due to a sudden reversal of the rolls he was cleaning (i.e. to and 8 from the bottom). The hessian wad was drawn in and held by the

now "in-running" rolls, having passed about 3 ins. through the rolls and remained there, although the calenderman had succeeded in withdrawing his hand at the critical moment.

Tests did not indicate the causation, and the machine ran satisfactorily the following day. Tregular running, however, was more frequent and further examination revealed signs of aroing on the end turns of one of the field coils. It appears that at times there was at frough circuit, and at others an open due to the occurrence of a break in the shunt field winding, causing the motor to stop and reverse on the interpole field.

Suitable protection against a shunt field failure would have prevented such an accident and should have been included in the control equipment of the machine. A shunt field voltmeter was provided, but this merely indicated that the supply to the shunt winding was in order and in no way revealed the passage of field current.

16. DANGER OF TRANSPORTABLE CRANES NEAR OVERHEAD LINES

Many fatal and non-fatal accidents have occurred as a result of machines, such as jib cranes, being used in the proximity of overhead electric lines and unfortunately the incidence of this type of accident shows no tendency to fall.

References to accidents of this character have appeared in Volume 14, Item 10 and Volume 15, Item 27, and the following example is of interest as showing that the danger is not confined to high tension lines, which account for the majority of the accidents. In the case described below a two-phase A.C. three-wire, 400 volt, line was involved.

The crane had an undercarriage mounted on four rubber-tyred wheels; it was not self-propelled, but was provided with a draw-bar. The top of the jib in the position it occupied at the time of the accident, was about twenty-four feet above ground fevel.

The overhead line, which transmitted electrical energy to a quarry, had been installed about trenty years before. The three bare conductors were arranged at the corners of a triangle, the two lower conductors being approximately intense free tabory ground level. Stored on the grass verge of a private road party beneath the overhead lines, were concrete feeding posts, some of which or the contract of the corner was more different posts of the contract of the corner was more different posts of the corner was more than the contract post of the corner was more than the contract post of the corner was considered to the corner was considered when the corner was considered to the corner of the corner

A fitter in a Fitting Shop nearby had heard cries and ran out towards the foreman who he thought had been trapped by the crane. He saw, however, the other man go to the machine and stiffen and fall, he then realized this was

due to electricity, and looked up and saw the steel hoisting rope of the crane touching one of the overhead line conductors. He ran and tripped the switchgear cutting off the electric supply; he then ran back to the crane and rendered assistance with other men who by this time had arrived on the scene. The foreman had been electrocuted but the other man recovered.

It seems possible that the foreman may have noticed the overhead lines and thought they were insulated because of their dark oxidated colour and relatively large diameter. Even if the conductors had originally been insulated, experient has demonstrated that cable insulation exposed to the weather should not be relied upon for the prevention of danger; such conductors about 8 to reach so her. It is quite insufficient to roy on instructions to the men concerned or on their own appraign properties of the control o

Lifts

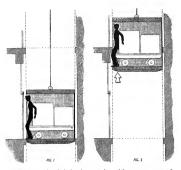
17. TRAPPED IN GOODS LIFT

An electric goods lift was being used to carry cases of goods between two floors of a factory. The cases were on begies and the whole load took up almost all the floor space of the cage. The lift was intended for goods only and it was not fitted with a cage gate. It could only be controlled by push-buttons at the landings, and in addition a notice at each landing said "Goods Lift Only. No Passengers Allowed".

A workman who knew that passengers should not travel in the lift decided to ride up with leads. He stood in the cage in the narrow space at the end of the bogic as shown in Fig. 1. He then closed the landing gate and asked as workmate to press the "up" "button. As the cage scaneded the mark leave were trapped by a projection under the upper landing sill, as shown in Fig. 2 were trapped by a projection under the upper landing sill, as shown in Fig. 2 in the projection was only 3 ins.; the man't keap were severely injuried.

The injured person was very foolish to endanger himself rather than walk up the stairs to the upper floor. His workmate who set the cage in motion was also to blame. He knew that passengers should not travel in the lift, and the accident would not have occurred if he had not co-operated with the injured person.

Apart from the irresponsible actions of these two men, the lift was not safe even for the carriage of goods. It did not comply with Section 22(5) of the Factories Act, 1937, as there was risk of trapping of the cases or the logic by the landing sill projection. It is good practice to fit a gate to the cages



of all lifts, irrespective of whether they are to be used for passengers or goods. Had such a cage gate been fitted in this case the circumstances giving rise to this accident could not have come about.

Storing and Stacking

18. DANGERS OF WORKING IN STORAGE BINS

The dangers of working in storage bins have been referred to in previous issues of this Séries, but serious accidents continue to occur due to persona being allowed to go on to material in bins in order to clear an obstruction or break up caked material. These accidents usually prove fatal and they occur in circumstances where entry to the bin was either not essential or where provision had not been made to prevent the man concerned being buried.

An accident in which the circumstances were particularly tragio occurred recently when two boys were killed in a bin used for the storage of gravel. In this case three men and the two boys had had to do repair work on the conveyor running across the top of the bin and, in order to get to a part where the work had to be done, a ladder had been placed on the gravel in the bin, which appeared

to be quite solid. On completion of the repair work the men and boys left the bin but did not remove the ladder, and some time later when gravel was being drawn from the bottom of the bin, the doors which controlled the flow jammed and it was found that the end of the ladder was preventing them from closing.

Drawing of gravel from the bin was stopped and the two boys were sent up on to the top of the material to try and locate the top end of the ladder and pull it out. The surface of the gravel still looked quite solid and afte. About half an hour later more gravel was required from the bin and as the boys could not be found on top of the bin, instructions were given to draw gravel from the bene, aithough the end of the ladder was still sicking partly through the doors. A small quantity of gravel had been taken from the bin when a boy's foot and afford the still t

As there were no witnesses of this accident, the exact sequence of events can only be surmised, but it is probable that a cavity formed and that when the boys started to move the gravel to try and find the ladder, a collapse occurred and they were engulfed.

No one should be allowed to go on to material in a storage bin or hopper on matter how firm or solid the surface may appear to be unless it is absolutely essential to do so and until all other methods of doing the necessary work have proved impracticable. When appear does have to go into such a bin or hopper, a suitable safety belt should be worn and the precautions detailed in Volume 11 Item 23 should be strictly observed.

The use of vibrators, either in the material, or fixed to the sides of the bin, can often ensure that the material flows properly, that cavities do not form and thereby the need for anyone to enter a bin can be obviated.

19. FAULTY LOADING OF WAGON

In the paint shop of an Engineering Works bundles of approximately fifty angle irans, 5 ft 6 fins. long and weighing about 10 owts, were dipped in a tar bath while suspended from an overhead crane. They were then lifted out and excess tar allowed to drain off, before being lowered on to portable cradles fitted to 3 ft. 6 ins. wide, flat top wagons, which travelled on raits through the shop. The cradles were designed to hold two bundles, or about 1 to no 16 wide.

One of the stackers, no doubt to save time, not only omitted to fit the cradles on a wagen, but even made ready to place a third bundle on top of the which was barely on the same and the same of the

In the foreground of the illustration is shown one of the two empty cradles on the succeeding wagon. These cradles, however, were designed to hold one hundred bars and would not, had they been used, necessarily have prevented the fall of part, at least, of the third bundle.

This accident well illustrates the old tag "more haste less speed"; it also shows that even in the case of experienced workness, especially those on piece work, supervision is essential. Not only did failure to use cradites bring about the accident described, but it also resulted in the class sing having to be consequent. The control of the control of the control of the control of the consequent likelihood of damage to the links. In addition, there would be difficulty in plaining a sling around the bars for unloading purposes.

For safety in slinging and stowing operations, careful supervision is indispensable.

Machine Tools

20. USE OF EMERY CLOTH AT LATHES

It has long been the practice for lathe operation to polish work in a lathe by the application of emery cloth. Many accidents have been caused, and a typical injury is "de-gloving" or removal of skin from the thumb. The most dangerous method of doing the work is that where the operator wraps a strip argument of the control of the properties of the properties of the properties. A safer method is to use a longer strip of cloth and he and en a can hand. This, however, is not to be regarded as an entirely safe method. For example, if the operator should cross the ends inadvertently and taken his give, one end may lip in between the cloth and the work, with a result such as that shown in photograph B. There is also danger in applying the control of the work is increased and the hand may be dranged to the work?

The safer methods are those which involve the attachment of emory cloth to an implement. The polithing risks (photograph C), in which the cloth is secured to a strong piece of wood, is the most common example. It is important that the stick should be of good material and strong enough for the duty, for a fracture would precipitate the operator on to the work, with a possibility of severe injury to the face.

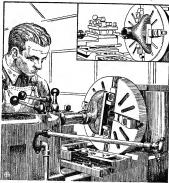
An arrangement which combines the benefits of keeping both hands at the front of the work, and also provides for considerable power, is the "nutcracker" shown at D. Two sticks, secured by a leather strap, are lined with emery cloth.

A method which removes the hands entirely from risk of injury is the use of the tool post, as indicated at E.

It should be noted that some of the methods shown often involve risk to the operator through contact with the jaws of the clute of with the lathe carrier. This is a further reason for adopting a method which keeps the hands as far away as possible, but the risk can also be reduced by the provision of after type carriers or clutels which have no projections. The wearing of long loose operators at lather and the practice should be discourased.

21. WORK FLIES OUT OF LATHE

A serious accident which occured by reason of the projection of a component from a lathe illustrates the dangers which may arise when out-of-balance work has to be dealt with. In this case a curved tubular component had to be machined on one end and, in order to arrange it for this operation, it was set up in the manner shown in the illustration. One end of the component was secured between three of the clutch jaws (with suitable packing pinces) and the other end which was to be machined was supported by a "running" centre.



As some care was required in the setting up of this work it was unpervised before being sanctioned for production. The speed determined by the supervisor was 160 r.p.m. After the operator had completed two components he submitted them for impaction and was then informed that further machining on material them for impaction and was then informed that further machining on machined it, but when the supervisor was required. He remounted the component and machined it, but when the submitted is the submitted that the centre void execution is shown inset, presumably because he thought that the centre void execution that the centre when the submitted is the submitted that the centre was the submitted that the close that the component became detailed from the chuck and struck the operator's ram, causing a compound fracture. On

investigation, it was discovered that the machine had in fact been running at 1,000 r.p.m., and while no clear resson was obtained for this change in running speed there is no doubt that this fact, coupled with neglect to use the running centre, rendered this sceddler extremely likely. The centrifugal force at a speed of 1,000 r.p.m. was about 37 times that when running at 160 r.p.m. so that, with an out-of-balance component of this kind, the centrifugal effect would be very substantial, even though the component was of aluminium. Although the results of the rendered that the rendered results are the rendered to result that wherever possible, effective fattures are designed for operations of this nature, as components can usually be much more effectively controlled than when existing equipment has to be adapted.

Machine Design

22. TRAPPED BY GEARWHEELS

The operator of a power-driven rotary cutting and bending machine in a packing acen flextory noticed that a piece of carefloard flat of legod in a lightening opening near the floor in the side frame of the smaches. In attempting to remove the certificated, one of his fingers was caught and injured by the instact of a pair of The opening in the machine frame was approximately 64 ints. 34 lins. and the instact of the generatives was approximately 64 ints. 34 lins. and the instact of the generateds was 34 lins. In from the outside face of the side frame.

It seems likely that the operator did not know that the gearwheels were accessible from the opening of the frame and, from his position well above the opening, he would not be able to see them.



This machine was only about two years old and the makers had given some attention to Section 17 of the Factories Act, 1937, of the Factories Act, 1937, wheels through this frame open wheels through this frame open showed that the gearwheels were neither completely encased no entither completely encased no situated as to be as safe as they would be if completely encased, which is the standard of protection required by this Section.

The guarding of gearwheels should receive very careful consideration when machines are being designed. When gearwheels appear in the preparation of a drawing, provision for their com-

plete encasement should follow automatically, and the drawing should not be regarded as complete until this has been done. In so many cases make-shift guards have to be added to the machine after it has been taken into use and sometimes, as in this case, not until an acident has occurred.

Woodworking Machinery

23. FATAL ACCIDENT AT CIRCULAR SAW

A sawyer decided to cut a board I inch thick from a piece of wood 22 inches long, I I inches wide and 2 inches thick by deep cutting through its width. The blade of the only saw available projected ? jinches above the table of the asset, the time the wood very cut makes a second cut to complete the partition. He moved the top guard to one side and removed the riving knife because it extended above the top of the saw.

Both cuts were successfully completed but, as the wood parted, one piece fell against the saw and was projected violently back, striking the sawyer on the jaw and causing fatal injuries. The absence of the riving knife allowed the cut piece to come into close contact with the saw plate and to be subjected to a powerful thrust by the crown of the saw.

Most of the fatal accidents on circular saws are caused by "throwbacis" and the majority of these occur when deep cutting is being done either, as in the case instanced above, due to the absence of a riving knife or to excessive loading of a dull saw. Under the latter circumstances the excessive heat generated causes the saw plate to buckle and bind during the progress of a cut; the saw slows down, but is liable to speed up rapidly if the woods of arvan back to ease the load, and the teeth near the crown of the saw tend to throw the wood back with zerest violence.

Extreme care should always be taken when the depth of the cut approaches the maximum of which hes saw is capible. In such a case it is most important that the teeth should be sharp and properly set. Work which would entail the saw being buried in the wood should, whenever possible, be transferred to a machine large enough to permit the wood to be parted by a single cut. A riving knift should always be used for work of this nature and, if the saw in use is too small to allow to normal hint to be used, either the saw should be replaced by one of sainble size, or sonder riving knift should be provided to

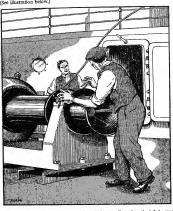
Ships

24. TRAPPED BY WINCH

A shore gang was engaged rigging a ship's derrick in order to unload cargo from No. 3 hold. The derrick having been lowered on to its rest and its cargo runner wound on the barrel of No. 3 winch, it was desired to wind its span rope on to the barrel of No. 2 winch so that the derrick boom might be readily raised or lowered whilst the load was attached.

Two turns of the span rope having been wound on and the tail of the rope led through its clamping hole in the barrel's rim, a man proceeded to secure the

rope tail to the barrel by means of a U but clamp. To do this, he ested his left hand on a sideframe bearing edicatest to the rin of a warp end barrel and gripped the tail but a side of the bles into which the clamp was to be inserted was not a side of the bles into which the clamp was to be inserted used to be side of the beautiful production for this to be done, he asked his mate out the winch harrel through about 90°. On the barrel rotating, his man was caught between the bearing and the jagged dego of the broken way end barrel, with the result that his arm was fractured and severely lacerated. (See illustration below)



The injured man was a most experienced rigger well used to the job he was doing. Although he acted, perhaps, in an unthinking way whilst his attention was focussed on correctly positioning the bolt holes, the primary cause of this accident was the use of a broken winch barrel.

To use a badly maintained machine is to invite accidents; it is, in fact, a highly dangerous procedure.

The Worker

25. FOOT ACCIDENTS



The figures above indicate three of the more common types of foot injuries which can usually be prevented by the use of safety potenear. According to H.M. Chief Inspector of Festoriet's Annual Report for 1932 over 28,000 accidents—practically one in its of all acadients—invented pipury government of a variety of causes contributed to this total, such as inadequate country of the contribution of the foot surface itself and had methods of handling articles. About three quarters of these accidents, however, occurred as a result of articles being dislodged or being dropped during handling, and such occurrences must be guided or being dropped during handling, and such occurrences must be regarded as inevitable in the course of everythy factory life. Most of the injuries need not, however, arise and it is estimated that two out of every three foot accidents inglit have been prevented by safety photowar.

It is often found that the false conomy of wearing out last year's "Sunday Bost" shoes in the factory has made an accident possible. Although much govern the value of after/ footware, long established habits are difficult to make the contract of the cont

1 Cmd. 9154-H.M. Stationery Office, price 6s. 8d.

Two British Standard Specifications deal with safety footwear. The first, "Strength Tests for the Protective Too-Caps of Footwear used for Industrial Purposes", specifies methods of test and performance requirements for protective toes of safety footwear for men and women. The second, "Men's Safety Boots and Shoes", specifies minimum requirements for safety boots and shoes provided with tested protective toe-Caps.



26. END OF FINGER PULLED OFF

At a manufacturing chemists, access between the filling and despatch departments was via an electrically operated sliding door, controlled by a photoelectric cell.

The operating light beam was intentionally arranged to be 7 ft. above floor level so that it was above the beads of persons walking about, but capable of being intercepted by drivers on their trucks carrying goods between the departments. When the door was required to be opened to allow the passage of a podestrian, the electronic circuit was operated by a push-button on the wall below the light beam.

The beam was provided by a 3 ins. diameter projection lamp located 8 ft. away from, and facing, the photo-electric cell. The glass front of the lamp was secured by a $\frac{1}{6}$ in. thick metal ring, a $\frac{1}{16}$ in. rubber washer being located between the glass and the ring.

One day a girl wanted to go through the door and instead of using the pushbutton, she decided on the much more difficult method of intercepting the light beam. Being of very short stature, she had to jump upwards to reach the lamp with her hand, and as she descended a thin ring on the third finger of

² B.S. 953: 1952 British Standards Institution, 2 Park Street, London, W.I. 3 B.S. 1870 - 1942

her right hand was caught on the edge of the lamp glass ring and embedded itself in the rubber washer. For a few seconds she was held suspended, but eventually her ring slipped over the first joint, failed to pass the second joint and completely pulled away the end of her finger as she fell to the floor.

This was a most unusual occurrence, it could not have been foreseen that the combination of the girl's perversity, her wearing of a ring and the edge on the lamp glass ring, would be the cause of an injury. This is the kind of accident that can, perhaps, only be avoided by discreet behaviour or prevented by strict supervision.

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No. 1—Renging of Hand-Field Pleton

No. 1—Fencing of Hand-Fed Platen Machines ... (Form 530) MISCELLANEOUS

MISCELLANEOUS

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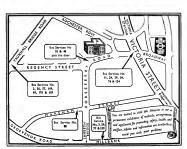


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Burst of Hydro-Extractor Basket (see page 9).

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Faulty Loading of Wagon (see opposite page)

ACCIDENTS

How they happen and HOW TO PREVENT THEM

Descriptions of Certain Accidents Notified to H.M. Inspectors of Factories

Published Quarterly
VOLUME 23 (NEW SERIES)
April, 1955

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MINISTRY OF LABOUR AND NATIONAL SERVICE

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LONDON: HER MAJESTY'S STATIONERY OFFICE
1955

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FOREWORD

In his recently published Annual Report for 1933, H.M. Chief Inspector of Factories* points out that the total working population reached a higher level 1953 than has ever been recorded in time of peace and that this rise in the total number of people at risk in factories is reflected by an appreciable increase, the first since the war, in the total number of accidents.

This increase in the number of accidents, 2.33 per cent, has occurred in all types of factories and has affected men, women, boys and girls. The total number of accidents is, however, lower than in any post war year with the exception of 1952, and it is encouraging to note that in spite of the increase in the overall figure the number of fatal accidents has continued to decrease.

A further encouraging factor is the steady reduction in the accident rate over the post-war period based on the number of accidents per thousand workers employed in factory premises. Although the rate for 1953 was 0.2 above that for 1952, this only represents an increase of 1 per cent and may not, it is hoped, indicate a change in the steady downward trend.

In a section of the Report dealing with accidents to young persons, the Chile Inspector say "Allowing young persons to be injunt or tilled is a form of recurring the matter within the strong of penalis below within with a section of penalis theory within with a swallest during the next decade can be appeared accurately; it is well known that it will be inadequate and that no strategic and be made good. Young persons in fact constitute industry's most perions raw material, and employers would do well to ask themselves if they are watching over it with all the cure it needs." The Report gives examples of accidents to young persons "in circumstances so deplorable that one questions whether certain employers are fit to be trusted with this previous raw material.

It is printed out that the ratio of machinery accidents to non-machinery accidents in greater in the case of young persons than adults. This is a persistent phenomenon and it is agreed among Inspectors that lack of proper instruction of young persons is the greatest single cause of these machinery accidents. It is said that the instruction of the young is often left to another young person or to an adult who is either insupable of the task or who is induspitates, and who by his conduct returns the proper of the property of the property

The Report, in dealing with accidents to older persons (i.e., aged 60 and over), points out that from a statistical point of view the fisk to such persons (in terms of reported accidents per thousand employed per year) is less than that for workers in the prime of life. The greatest single cause of accident is handing goods and this a isolate point of the proper of the proper of the contraction of the proper of the

A large part of the Report deals with accidents in particular industries, accidents due to selected causes, accidents at various types of machinery and accidents due to fire explosion and electricity. This forms a valuable review of safety in industry.

of safety in industry.

*Annual Report of the Calef Inspector of Factories for 1953. Cmd. 9330 H.M. Stationery Office, price 6s. 6d.

Statistics given for eye injuried due to particles or fragments thrown off in the course of factory procuses, above that there has been a fairly standy reduction in the rate per thousand persons employed. The rate in 1947 was 4938 streams in 1933 it had fallen to 6.35. It is pointed out that this class of excellent sents about 60 per cent of all eye injuries and is one which might be prevented by providing protection for the eyes. The remaining 40 per cent of eye accelerate are due to miscellaneous mishaps which general care and good housekeeping can often prevent. A list is given of some of the leguides causing eye injuries in particular classes of work and an interesting table shows the distribution of eye accidents among the various groups of industries.

Braking of Railway Wagons

There is a tory told somewhere of a newspaper editor who, having to deal with an inter rander who had seen his death reported in the paper, rave to tay that the paper never admitted mistakes but that, as a concession, the renders mane would appear in the "Births" column in the next issue. We do not cake the same attitude in regard to mistakes in this publication. In fact we are slawy glad to take the opportunity of acknowledging an error especially if it happens to be one in which the subsequent correction enables emphasis to be put on a particular aspect of safety.

Such a case arises in connection with the illustration on page 13 of Volume 21 (Cotober, 1934) where the brake lever of the railway wagon was shown in the "off" position. The brake should, of course, have been "on "in accordance with good safe practice before any attempt was made to enter the wagon. It is rewarding to know that our readers are alert to dangerous conditions and, we hope, able thereby to avort the accident which might have been foreseen.

Our purpose in this publication is to show how accidents can be prevenued by taking note of the mistakes of others. We have been criticated from into to time for always having an answer to the faults of others and being ready to "draw the moral "at every opportunity. This is natural in a safety publication of this kind, but it may be relievabling to readers to know that we are far from mistakes of the state of the sta

INDUSTRIAL ACCIDENTS

VOLUME 23 (NEW SERIES)

The description of accidents and accompanying illustrations or diagrams in this publication are intended only for future guidance in select matters and not to convey implications as to the extent, if any, to which particular individuals or firms may have been to blame in connection with the accidents in question.

Printing and Allied Machinery

METHOD OF WORKING RENDERED TRIP GUARD INEFFECTIVE

Hand-fed platen machines have long been recognised as dangerous machines and in 1938, as a result of discussions between representatives of users and makers of these machines and the Factory Department, minimum stundards of performance were agreed for automatic trip, or "stop motion", guarda. Notes programment of the properties of the properties of the properties of the parameter of the properties of the parameter of the properties of the p

A recent accident at a cutting and creasing platen has drawn attention to a hortcoming in the automatic trip guard which was not forescen during the discussions in 1938. The operator was feeding work to the machine when her right hand was trapped and creasted between the platen and forms. The machine was firted with a conventional automatic trip guard which was apparently in present the scale of the platent of the platent platent of the present present the accelerate, beause the operator happened to be standing with one of her feet on the starting podal, thereby preventing the clutch being withdrawn by the action of the trip guard. It was of course unnecessary to maintain pressure on the pedal once the clutch had been engaged. This is a disturbing type of scieding as it could similarly occur on many platen machines row in use. Some recently designed machines incorporate a drove which disconnects the clutch from the influence of the podel once the clutch has been engaged and so climinate

^{*}Factory Department Form 530 "Fencing of Hand-Fed Platen Machines"—H.M. Stationery Office—price 3d.

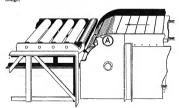
This accident shows the necessity for careful training of all platen machine operators so that they do not keep a foot on the starting pedal, or pressure on the starting lever, after the machine has been started. Attention to this should also be included for the scheme of instruction and training for young persons required by Section 12 of the Factorias Act, 1927, platen printing machines required by Section 21 of the Factorias Act, 1927, platen printing machines are proposed to the scheme of the Section 12 of the Factorias Act, 1927, platen printing machines are proposed to the Section 1920 of the

Conveyors

2. TRAPPING AT CONVEYORS

A large number of accidents occur at the trap where the moving band or slats of a conveyor meet some fixed part of the plant such as a hopper, table or idle roller conveyor. In an analysis of accidents for one year at band conveyors, it was found that over 30% of the accidents were of this type.

This trap often occurs just at the point where the conveyor must be approached for the handling of goods. Where there is possibility of access, the trap should be either eliminated or guarded. Sufficient clearance to prevent danger can sometimes be provided or the risk of injury can be prevented by design.



The illustration above shows the trap A between a slat conveyor and an idle roller conveyor. Risk of trapping has been avoided by making the first idle roller free to move away from the slats along an incline cut in the sides of the conveyor. The angle of the incline is so arranged as to revent lateral

^{*}S.I. 1954. No. 921.

movement of the roller during passage of goods from the slat to the roller conveyor.

In addition to the above types of accidents, it is equally important to obviate the risk of trapping at the "nips" between bands or slats and the main driving or driven drums.

Iron and Steel

3. FALL INTO SLAG PIT

A workman was repairing the launder (spout) after tapping a fixed open hearth furnace. To do this he stood on a loose plate which he had thrown across the gap in the back stage of the furnace. The plate was insecure and it moved under the weight of the man so that he fell into the slag pit. Fortunately there was no slag in the pit and so the man only suffered abrasions.

It was discovered later that he had found the plate provided for the purpose to be too heavy and had substituted the smaller, lighter, plate which gave rise to the accident. However, lightweight plates are now being used, but with "T" bars welded to them on the underside to stiffen them and also provide

means of locating them over the gap so that they will be firmly held in position.

There is always some risk when working at the launder or at the tap hole of an open hearth furnace and everything possible should be done to reduce this to the minimum. The plates on which the men stand should be as light

of an open hearth furnace and everything possible should be done to reduce this to the minimum. The plates on which the men stands should be as light as possible consistent with providing an adequate and secure working place. A proper degree of maintenance is also necessary since warped plates can be very dangerous and locating devices must engage properly.

4. DRUM DROPPED ON FELLOW WORKMAN

The effects of foolish and thoughtless actions are well demonstrated by an acident which courmed in a stell works. Two men found, on a melting stage, an empty oil drum which they wanted at ground level, 30 feet below the stage. A gangaway connected the melting stage with the top storry of an adjourn building, being almost vertically above the entrance to the building at ground level. The men rolled the oil drum along the gangaway and since they were in a hurry they decided to throw the dum over the gangaw and since they were in a hurry they decided to throw the dum over the gangaway to see that no being the stage of the s

sutneers to keep thin in nospital rol' about a week.

Accidents of this kind may involve consideration of Section 119(2) of the Factories Act, 1937, which makes it as offence for any person willfully and without reasonable cause to do anything likely to endanger himself or others. Apart from that, the occurrence of an accident near the section of the action of the section of the

Electricity

5. WELDER ELECTROCUTED AT 95 VOLTS A.C.

Electric welders at a shippard found that they had need of artificial lighting in dark, out-of-the-way, corners not covered by the general temporary lighting provided on the ship. Instead of using properly constructed equipment capable of connection to the temporary lighting installation, portable handlamps were pectively with a short sharp nail and a stout wire "S" book. Light was obtained by sticking the nail through the rubber sheath and into the conductor of the welding cable, the "S" hook being hung on the earthed metalwork of the ship to form the return circuit.

A 30 year old welder whilst carrying his equipment on his shoulder from one location to another with the welding lead tive, received a fixed electric shock from the "8" hook which was live at 35 voils through the 60 watt lamp. The welder may not have appreciated that the hook, when not connected to the welder may not have appreciated that the hook, when not connected to the live condition of his electrode and holder, which he took cars to hold in his glowed right hand clear of earthed metalwork to prevent arcing.

This fatality draws attention to the danger of using makeshift lighting arrangements. Had properly constructed lighting equipment been used the accident would not have happened.

6. FATAL SHOCK FROM PORTABLE BLOWER

Two men walking along a quayside to their work came upon a young man pling unconscious on his back in a puddle of water, his hand grasping the handle of a portable electric blower which lay on his chest. (Fer illustration opposite). The cable of the blower was plugged into a metal socket do to the wall of a nearby wavehouse, and the 230 volt AC. supply was switched to the wall of a nearby wavehouse, and the 230 volt AC. supply was switched to the wall of a nearby wavehouse, and the 250 volt AC. supply was switched to the best of the supply of the supply of the supply was switched to the best of the supply of the supply of the supply of the The blower was then dragged away by its cable, and artificial respiration was promptly applied to the boy. However, in spite of this, he died.

After the accident, the blower, its three-core cable and three-jin plug were found to be in good order, but the insulation of the socket has finled, bence making the metal casing of the socket alive. The metalwork of the blower then became alive wit the earth core of the flustible cable. Normally, had the earthing of the apparatus been effective, no danger would have arisen, and the fuses pre-testing the circuit would have blown immediately. In fact, however, the metal-work of the socket, and hence of the blower, was connected to an earth electrode consisting of 2 feet of ‡ in . diameter steed conduit driven into sals and rubble which formed the surface of the quaysids. The resistance from the apparatus to the activities motival point of the supply transformer some distance away to the control of the cont

It is continually being stressed, and it cannot be stressed too often, that single short earth electrodes of the hind described, and even considerably more substantial spike or pipe electrodes, are almost always entirely ineffective content of the stress one of the best earth electrodes, but in cases where connection to such a system is not possible, and a separate earth electrode must be constructed, the latter must be designed and installed with greak care, and not brought into cannot be the latter to the stress of the stress

Ships

7. FAILURE OF SHIP'S SINGLE-SHEAVE DERRICK HEAD CARGO BLOCK

A swinging derrick, rigged as shown in the illustration opposite, was being used to lift a comparatively light load consisting of a tray on which bags of cement were stacked, from a barge into a ship's hold when the derrick head block failed and fell to the deck.

The load being lifted was well within the capacity of the block which, as required by Regulation 19 of the Docks Regulations, 1934,* had been tested with a proof load of four times its safe working load.

Broadly speaking, the design of the block was as shown in the diagram on page 10. Examination of the broken block showed that the two nuts "A" were missing; evidently they had become loose and unscrewed, so that their boots fell out. This, in is turn, allowed the forged eye, shank and collect to pail out, the collar had not ever the state of the broken the state of the collar block of the state of the state of the state of the state of the collar block of the state of the causing sever injuries to his bead.

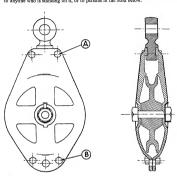
causing sever injuries on in feat.

Although that the sign of the clast, there is always the danger that in order to infinite the risk of the clast per that in order to infinite the risk of their working loose, some of the nuts A or B will be served up too ightly, too damaging the bolt and nut threads. Only only only of their border is danger of nuts working loose, locking devices should be fitted; in this case the operation of spirit inswould, most likely, have prevented this accident. Further, although Docks Regulation for the proceding three months, shall be impected by a competent person immediately before each occasion on which they are used in hoisting or lowering, it is nevertheless good practice to give any piece of Regulations generally only specify the minimum requirements which are much more as it is practicable being of the practice of the procedure of the procedure

Incidentally, the illustration calls attention to the frequently seen, but nevertheless bad, practice of leaving wooden hatch covers strewn about the deck

^{*}S.R. & O. 1934, No. 279.

where they are very liable to be damaged. Docks Regulation 15 requires that all hatch coverings shall be maintained in good condition because a damaged hatch cover is likely to come away from its hatch beams with disastrous results to anyone who is standing on it, or to persons in the hold below.



Lighting

8. FALL INTO LOADING DOCK

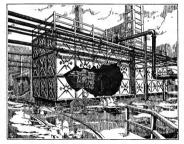
In the floor of the despatch department of a large engineering works there was a loading dock, lighted by powerful overhead light controlled from switches situated on the street wall near the door. One evening, a fitter was instructed to make some last minute additions to a machine, already moved to the despatich department. On entering this department through a small door from the fitting shop, he found the place in total darkness and decided to switch on the overhead lights. He knew roughly where the light switches were located, and while groping his way in pitch darkness between crates and machines, he fell into the loading dook. As a result his right wrist was fractured, and he was off work for a lengthy period.

It is not always appreciated that not only must parts of the factory where persons work or pass, he sufficiently and suitably lighted, but in addition the switches should be placed in convenient and accessible places. In this instance, the property of the place of

Storage Tanks

9. FAILURE OF LARGE CAST IRON TANK

In a chemical works in which ammonium sulphate was manufactured by the distillation of crude gas liquor was a battery of cast iron tanks each capable of holding 36,000 gallons of liquor. At a time when about 1,500 gallons of liquor had been pumped from a tanker vehicle into a tank, bringing the height of liquor in the tank to approximately 13 feet, it suddenly fractured with the result that over 30,000 gallons of liquor were released, some of which flowed into the

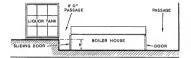


boiler houses. Fortunately, four of the men working in these houses were able to escape by means of doors in the sides of the houses away from the tank; a did man, however, was prevented from doing so as the door by which he tried to escape had, anonarently, become inaccessible due to plant washed against it

by the liquor. He was seen to stumble and fall into the liquor; although rescued by men wearing breathing apparatus he died from asphyxiation and chemical burns the same day.

The tank was about forty years old and for the last twenty years it had been used for storing an aqueous solution of crude liquor containing about 15 to 20 per cent of ammonia.

The illustration on page II shows the tank and the extent to which it was changed. Its dimensions were approximately 25 feet by 15 f



The small diagram above shows that whereas the bottom of the tank on one side was level with the ground, on the other side it was about 6 feet above the level of the 6 foot wide passage which gave access to the boiler houses.

In 1946, manhole covers had been removed in order to remove sludge from the tank and from a visual examination made by booking through these openings and from the top of tenk, the stays appeared to be in reasonably good condition; examination after the occurrence, however, showed that of be bottom ten 1½ inch stays the largest was now 1½, inches, four were 1 fanch and the smallest ½ inch; of the ten middle 1½ inch stays, the two largest with the smallest 3½ inches; for the top five 1½ inch stays the three smallest were 1½ inches; of the top five 1½ inch stays the three smallest were 1½ inches; of

There is no doubt that failure of the panel sides followed fracture of the bottom and middle row tie rods.

The lesson to be learned from this tragic occurrence is the necessity of examining throughly and at regular intervals the condition of structures we had a tasks which are subjected to considerable stress, of recording their condition in a written report and of ensuring that any defect found affecting safety remedied. To leave unexamined for a period of about seven years a forty wars old metal tank which contained correlive liquor is to court trouble; it is no consolation to know that it had been decided prior to the occurrence to replace this old tank.

Textile Machinery

DANGER OF INADEQUATE GUARDS

An accident which occurred at a preparer gill box in a woolcombing mill shows how a false sense of security can be engendered by incomplete guards which mask the danger point without providing real protection.

The muchine was thirty years old and no improvement had been made to the original incomplete guards so commonly provided at that time by the makers of textile muchinery. At the feed side of the machine, the drive from the back shaft to the serve shafts for the faller combin included a pair of bevel getarwheels of inches in diameter, about? Get 9 inches above the floor. A substantial guard for the serve of the state of the lowest point leavine exposed the "in" which was on the underside.

A man, a new arrival at the factory, was advised by a follow worker to keep his desaing; cloth on a horizontal har forming part of the framework of the machine, which ran under the feed sheet and the bevel gearwheels. On his sixth day at the mille bestared the machine after cleaning and then went to replace his cloth on the bar. As he was doing so, the cloth caught in the intake of the bevel wheels, pulled his hand under the lower edge of the guard and he lost half of his little finger in the "nip". Following this accident, complete enclosures are being provided for all such gearwheels.

Hoists and Teagles

11. HAND CAUGHT IN HOIST CHAIN

At a flour mill the sack hoist consisted of a single chain, wound on a drun at the top of the building and passing through the building so that sacks could be hoisted through trap doors in the floors. Control of the hoist was by a rope which ran through the various floors near the trap doors, it did not, however, extend to the ground floor as it was considered dangerous to have a hanging control rope where whiches are moved about during unloading.

A man was attaching sacks to the heaisting chains at the ground floor and another man was operating the control rope and unloading the seals at the top floor. On one occasion the hoisting chain was not lowered enough and the man on the ground floor shipped his hand through the loop at the end of the chain and pulled on it to try to brings it lower. In doing this he shoot the chain and this applied to it to try to brings it lower. In doing this he shoot the chain and this was the control rope. Before the man at the ground floor could free his hand, he was lifted off his feet and hoisted up through the building, his head opening each trap door in turn, which then automatically clored behind him (see literature) on puge 14. Although the man struggled, he was unable either to free himself the could be seriously injured, the driving belt was thrown off the drum pulley, he could be seriously injured, the driving belt was thrown off the drum pulley.



This unusual accident draws attention to the need for some properly organised system of communication between the floors such as a telephone or speaking tube. The men in this case were relying on a shake on the hoisting chain to act as the signal to hoist. This method of communication is clearly open to misimteroretation and might well, in the case described, have led to serious hintries.

12. FENCING OF TEAGLE OPENINGS

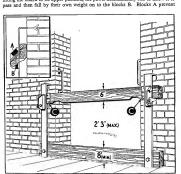
There is a serious risk of falling from teagle openings in the walls of buildings and Section 22(10) of the Factories Act, 1937 requires that such openings shall be securely fenced and be provided with a secure hand-hold on each side. The

fencing has to be properly maintained and, except when the hoisting or lowering of goods is being carried on at the opening, kept in position.

Various methods of fencing teagle openings are in use and these include full doors, half doors, and the use of bars or chains. Half doors should be at least 3 feet high and where bars or chains are used they should also be not less than 3 feet above floor level. In addition, where bars or chains are used, an additional bar or chain should be provided about I foot above floor level to prevent a nervon falling out of the opening under the upper bar or chain.

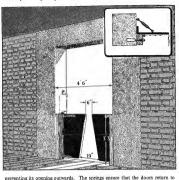
The provision of a secure hand-hold on each side of the opening is most important as persons working at the openings often lean out to observe the load and in so doing they are liable to lose their balance unless a secure hand-hold is provided. A handle about 14 inches long, made from round bur, is the usual form of hand-hold. The middle of the hand-hold should be about 4 feet from the floor.

The faceting shown in illustration below consists of a fixed toe-board and a waveful-uper board held in two steel side members. When the opening is not in use the upper board is supported by two pawls which in turn rest on the blocks B (see insule). The pawls can be lifted to allow lowering of the board which, however, is prevented from being moved sideways by the plates C. On diffing the board to its upper position, the pawls automatically rise to allow it to



the pawls falling so far over as to prevent their return by gravity on to blocks B. The hand-hold at each side of the opening is clearly shown.

The illustration below shows a type of door fencing which is suitable where sacks are taken in, e.g., at a bakery. The two spring-loaded doors are so made that they can only be opened inwards, a return angle on each door (see inset)



preventing its opening outwards. The springs ensure that the doors return to the closed position after the passage of the sack. The doors are so shaped as to facilitate their opening by the incoming sack. One of the hand-holds can be seen at the side of the opening.

Building and Constructional Work

13. FAILURE OF REINFORCEMENT FOR PRESTRESSED

In one method of making prestressed reinforced concrete beams, the reinforcement, usually a large number of small diameter high tensile steel wires, is is poured. The moulds are sometimes several hundred feet in length, divided into sections according to the lengths of the beams.

The load applied to the reinforcing wires is considerable and if any of the wires break whilst this is being done, they whip out of the moulds with great

The load applied to the familiary may be the followed the analyst the wires break whilst this is being done, they whip out of the moulds with great violence.

In one case where this risk was appreciated, safety straps had been placed.

In one case where this risk was appreciated, startly straps had been placed across the moulds about every 50 feet; these consisted of short lengths of a tinch diameter steel wire rope secured to the frame of the mould by steel dips, because the strain of the mould by steel dips, because the strain of the mould be strain or the strain of the strain of

The straps had not been properly secured to their auchorage and they were not designed so that they could be fitted easily and securely. In addition, the spacing of the straps at 50 foot intervals obviously does not give compiler protection from a frign wire and a better aufegant, which is used by a number of firms, is an inverted ""U" shaped guard made of heavy gauge mesh or capsated metal, which can be placed over the entirelocoment before streaming

14. MISUSE OF BUILDERS' PLANT

The misuse of builders' plant continues to result in injury to workpeople and in damage to plant and structures; the following two cases are typical of this class of accident.

Disused east iron scruibbers 60 feet high and 15 feet in diameter were being demolished at a gas works. The bolts seeming the plates had corroded so that it was impossible to undo them and, because the towers were impregnated with maphthaline, the risk of fire was to organt to use a host cutting process. Rather than demolish the scruibbers by hand, the foreman, a man with 30 years' experience, decided to utilise a mobile crane with a 50 nost jib. A1 flow with was suspended from the jib and, by running the crane to and fro, the weight was assued to swing and strike the scruibbers. During the operations, and while lafting in the jib, the weight swamp back and struck the jib, bending it back post the control of the property of the control on work by swingings a weight with a crane were, in this case, aggravated by the low ratings of the crane used, the safe working load at 17 feet radius belong only 14 ews.

The second case effectively illustrates the serious consequences of disregarding regulations made for safety in a misplaced attempt to "help".

An elderly labourer was employed on a building site to collect ten orders and this involved going pur vice a slay to the fourth floor of the building under construction. The driver of a platform hoist thought that he would "slept the old chap "by giving him a lift up and down on the platform of the boist, despite a clear notice on the hoist prohibiting the carriage of persons. As the labourer was riding down on the platform, he driver lost control of the boist, due to dust blowing into his eyes, and he failed to stop the platform soft.

15. SUSPENDED SCAFFOLD COLLAPSE

While two men were working in a cradle cleaning the external surface of a building, a rigger clambered out of an upper floor window, about 70 feet above the ground, and started to climb up one of the fall ropes in order to reach the roof. He could, however, have reached the roof from inside the building.

The cradic was suspended by the usual type of rope and pulley gear attached to two timber outriggers about 20 feet long whose diameter ranged from 5½ inches to 2½ inches. These outriggers rested on the roof parapet and extended back over a flat roof in the shape of a " V", being lashed to ogsther near their inner ends and having two 56 lb. weights lashed to them at this point. The overhang beyond the parapet was approximately 18 inches.

As the man climbed up the rope, the outriggers upended and the three men and all the gear fell to the ground (see illustration opposite). The man, who fell 70 feet, and a passer by, who was struck by the falling equipment, were severely injured.

With two men in the cradle, the counterweight effect obtained with the "set up" as described was only 1.6 times the dead load and when the third man added his weight plus the jerks due to climbing, the ratio would, be reduced to one or perhaps less, i.e., the counterweights were insufficient to ensure stability.

There were breaches of the Building (Safety, Health and Welfare) Regulations, 1948² in that parts of the scaffold were not kept so fixed, secured or placed in position as to prevent accidental displacement (Regulation 91; the scaffold was not securely supported or supended (Regulation 172); the outriggers were not firmly anchored at the inner ends (Regulation 172).

Whilst no hard and fast rule can be laid down to cover all circunstances, it can be said that a safety factor of three is a minimum when counterweights are used for anchoring outriggers. Where practicable, the linner ends of outriggers should be fixed to permanent and secure fixings on the building and in a case should guttering or drainpipes be used. Where permanent anchonage points are not available and counterweights have to be used, the outriggers should be run back; parallel to each other, a cross pole should be used for "tailing down" and some means of preventing lateral movement of the out-

16. COLLAPSE OF ROOF TRUSSES

A further instance illustrating the instability during erection of certain types of buildings has recently occurred.

A single storey building, 140 feet long by 30 feet wide, was constructed with hirthc walls which carried steet or for russe at 11 feet cutters, and errection had reached a point where the latter had been placed on the walls and secured together by bottleng mandom lengths of timber to some of the purific desix on each roof slope. The trues stose were not botled to the walls, although provision each roof slope. The trues these were not benefit on the walls, although provision satisfies the shell wall.

Several men then started to fix the permanent timber purlins and, as these had been cut and drilled on the ground, this work should have been simple.

^{*}S.I. 1948, No. 1145.



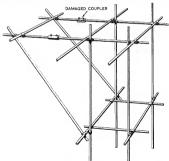
Suspended Scaffold Collapse (see opposite page)
19

hut at the third truss it was found that the fixing holts could not be inserted hecause the holes in the purlin and in the cleat were out of line. In order to rectify this the temporary timher ties to the third truss were unbolted and an effort made to move the truss slightly, but almost immediately the truss fell over and carried all the other trusses with it.

Regulation 94(1) of the Building (Safety, Health and Welfare) Regulationsrequires that guys, stays or other supports should be used where necessary to prevent collapse of a building during its construction. Had the third truss been secured by means of gay ropes or seaffed) polse hefore the batten was unboiled, the accident would not have taken place. Additionally, the trusses should, after erection, have heen holted to the walls as soon as particiable.

17. COLLAPSE OF CANTILEVER SCAFFOLD

A tubular scaffold had been erected to a height of some 60 feet in the hoiler house of a power station when it was found necessary to extend the working platform at one side near the top, and the scaffolder decided to do this hy building



a small cantilever section out from the main scaffold. As the existing putlogs did not extend sufficiently far to carry the platform, he increased their length

^{*}S.I. 1948. No. 1145.

by connecting to them 6 foot lengths of tuiling, making a but joint secured with a slevee coupler and then fitting raker tubes between the ends of the extended putlogs and a ledger on a lower lift with swived couplers (see diagram opposite). He next started to recet uprights for guard mils and had just placed one foot on one of the original putlogs and the other on one of the extension thus, when the latter pulled out of the slevee coupler, due to his weight, and the cantilever section of the scattering the sleve coupler, due to his weight, and the cantilever section of the scattering the sleve coupler, due to his weight, and the cantilever section of the scattering scattering the sleve coupler, dualing section injuries.

The collapse of this small scaffold was primarily caused by the use of an amusuitable slewer coupler to connect seaffold tubes which would be in tension when under load. Examination of the slewer coupler after the accident showed that it was damaged, having hear distorted at some time previous to the accident hy over tightening the two securing holts, and this distortion prevented the holts from being ingilized scaling light search with the scale of the control of the scale of the

It should be remembered that joint pins and some types of sleeve coupler for turbuler satisficiding are only obtained for texpins the tithse in axial slignment and will not necessarily carry a tenuile loud. Where scaffod tubes may be intention, joints are best made by lapping the tubes over each other and securing them together with couplen designed to withstand a tenuile load or, preferable, one long length of the should be abstituted. The accident emphasizes the need for seeing that men erecting or altering scaffolds are either fully competent for the task they have to underface over an effective stranded for all supervised, or the security of the second of the security of the second of the

Gassing

18. NITROUS FUME GASSING IN SHIPYARDS

Whenever an intensely hot flame plays upon the surface of a large mass of old metal, appreciable quantities of nitrous times are likely to be formed by combination of the oxygen and nitrogen of the air and, if this is occurring in many uself reach a dangerous figure. Precisely these conditions may obtain in the steering compartment of a ship when a heavy steel crosshead is being heater of the property of the pr

^{*}S.I. 1948, No. 1145.

Two recent accidents have drawn attention again to this risk, although in both these cases, fortunately, the men affected made complete recovery.

In the first case, the steering compartment measured 20 feet long, 12 feet, wide and 7 feet high. Openings into it consisted of a stairway 3 feet by 2 feet, and two ventilator openings in the deck, each I foot in diameter. An 8 inches, connected to a blower, was introduced through one ventilator openings, and a compressed air line through the other. Despite these precautions, the condition of the atmosphere in the compartment became intolerable, and the men at work there had to leave. One man, who said that the atmosphere bad a distinctly said entail, received a moderate degree of the properties of the control of

The second case occurred during repairs to a ship in dry dock, in the course of which it became necessary to remove the six 24 inch bolts of a coupling on the rudder-stock. Attempts were made, without success, to loosen the nuts by means of a spanner, and a hammer and sett. An oxy-acetylene torch was then brought in to heat the nuts, but this failed to free them. The nuts were eventually burnt off with an oxy-acetylene cutter. Similar difficulty arose in the removal of the bolts, and the oxy-acetylene burners were again brought into use in efforts to free them. Ultimately the bolts had to be drilled out. As usual, all this work was going on in a very confined space. The repairs were of an emergency nature, and there was anxiety to get the ship away without delay. so that the work was started before proper arrangements could be made for ventilation. All four men engaged on this work were affected; one of them collapsed some time after, a typical symptom of nitrous fume poisoning. This accident was clearly due to the failure to provide ventilation adequate for the removal of injurious fumes arising from the use of oxy-acetylene burners, a breach of Regulation 18(a)(ii) of the Shipbuilding Regulations, 1931.*

19. GASSING AT STEP GRATE PRODUCERS

From time to time, gasting accidents, sometimes fatal, occur on the charging stage of the step grate producers associated with vertical retorts in gastrost. When a lid is pulled away from a feed opening, there is a copious release of producer gas and consequent risk of gasting subsets precautionary measures are taken. The danger is well recognised, and it is now customary in gasworks to provide some means of lighting the gas as soon as the lid is lifted. Two methods of doing this are illustrated in the Memorandum on Carbon Monoxide Poisonina.*

It is not only at charging that there is a risk of gassing. In the course of time, a the lids may warp and not set properly when they are replaced, allowing a small but continuous secape of producer gas to occur. Tests have shown that in such circumstances the concentration of carbon monoxide can build up to a figure well in excess of what is regarded as the safe maximum. Where the lids and seatings are of tapered cross-section, a tool such as that shown in the illustration opposite will be found useful. The tool engages with the handle of the lidy which can be given a few turns after it has been replaced on its seating.

^{*}S.R. & O. 1931, No. 133. †Factory Form 827—H.M. Stationery Office, price 4d.



by this means the ind and seating can be kept ground to a reasonably gastight fit.

The illustration shows also a two-hooked tool used in removing lids from producers. The design minimizes the risk of accident by unintentional disengagement while the lid is being lifted or dragged across the charging floor.

Steam Plant

20. EXPLOSION FROM A LANCASHIRE BOILER

An explosion from a Lancashire boiler occurred in the early morning when the attendant opened the flue dampers and started up the automatic stoker. Fortunately no one was injured. The subsequent investigation revealed that there had been a serious shortage of water within the boiler. The attendant apparently failed to take notice of a warning from the high-low water alarm, and had assumed, when he could not see a level in the water gauges, that the water was above the top of the glass tube, but he did not check this

It should never be assumed that the water level in a boiler is correct by mere visual examination of the gauges, the cocks on the gauge fitting should be operated to ascertain whether the glass is full or empty and to ensure that the gauge connections to the boiler are unobstructed.

21. EXPLOSION FROM BOILER BLOW-DOWN PIPE

A workman was severely scalded when the cast iron elbow on the blow-down pipe from a Lancashire boiler exploded whilst steam was being raised following the fourteen monthly statutory examination of the boiler.

The pipe, which was not included in the examination which had just been completed, was found, during the investigation into the occurrence, to bave contained porous metal over a length of 2½ inches at the point where failure took place. Whilst this defertive metal was a contributory cause, the principal trouble was unsatisfactory installation whereby the pipe was rigidly fixed in position with no provision for movement during leasting and cooling. Constituently the provision for movement during leasting and cooling. Constituently we have been considered that the position which occurred during the raising of steam and finally the metal, which had been overstreased many times, gave way.

This type of accident is now more rare than was the case years ago and there is no doubt that this improvement is due in a large measure to blow-down systems being arranged to allow freedom of movement for expansion and contraction. In addition, in later installations, east iron pipes have largely been discarded in favour of steet.

Lifting Tackle

22. FAULTY SLINGING AND IMPROPER USE OF FORK LIFT TRUCK

It was decided to lift 20 foot long bundles of steel bars, each bundle weighing about 1 ton, from the lorry delivering them, on to cradles used to facilitate their transport within the factory.

their transport within the factory.

Each bundle was fastened in three places by \(\frac{1}{2}\) inch diameter steel wire and
to do the job, a two-leg chain sling was wrapped around the forks of a fork
lift truck, as shown in the illustration opposite, the less being reeved through

the two end wire bindings.

Suddenly, one of these bindings broke. The fork lift truck, now exposed to a side pull acting through considerable leverage, overturned and fell on the driver, fatally crushing him.

There are, indeed, many lessons to he learned from this occurrence. First, it was dangerous to use a fork lift truck in such a manner that it was exposed to side pulls acting through a considerable leverage; even the swinging of the load would cause an unsafe transverse upsetting moment. Many makers affix to their trucks a plate on which are indicated the maximum loads, based on the longitudinal (not transverse) stability of the machine, that may be safely lifted when the centres of gravity of these loads are at stated distances from the heel of the forks; it had, however, never heen foreseen that a sideways pull would he applied to a truck as shown. Secondly, the tensile breaking strength of the binding would approximate to 20 cwts, so that, had the angle at the apex of a hinding-each binding was hound tightly around its bundle-at its junction with the chain sling been, say, 120°, the corresponding pull in the hinding would have been about 20 cwts., i.e., equal to its breaking strength. Thirdly, the strength of the twisted connection in the binding wire was an unknown quantity and, in point of fact, these hinding wires should not have been used for lifting the hundle, which should have been done by passing the chain sling round the hundle. Fourthly, the chain sling should not have been wound around the sharp edges of the forks without the use of packing for, as the illustration indicates, the links were subjected to bending moments for which they were never designed. Lastly, but hy no means the least important, it is obvious that the work of the men was not being supervised. It so frequently happens that lack of careful supervision is a primary factor in the causation of lifting accidents.

Machine Tools

23. STRUCK BY WHIRLING BAR

The operator of a turret har lathe had put a $\frac{1}{N}$ inch diameter bar in the headstock and was preparing to polish it hefore cutting off a 2 foot length. He ran the machine at 750 R.P.M. and, hecause the bar projected over 2 feet from the headstock, it began to whip. Almost immediately it fractured, striking the operator, who received injuries to his arm and hand.

Having regard to the diameter and the speed at which it was running the projection of the bar from the headstock was too great in the absence of further support.

The danger of whirling hars has already heen referred to in this Series at Vol. 18, item 3.

24. RING CAUSES LOSS OF FINGER

An accident, in which a man lost a finger, illustrates once again the risks run by workers who pential in waring finger rings while engaged in the operation of machine tools which have exposed revolving parts of small diameter. The operator was working at a three spindle, sensitive disting machine, the work beginning that in all goal to the control of the control of the control of the spindle of the control of the control of the control of the control of the competion. While working at the first stage, and having completed this part of the work, it would appear that the operator's finger encountered the drill as he was removing the jig. The drill became entangled in the ring and the finger was severed.

finger was severed.

The top photograph facing page 25, shows that in its upper position the drill was only just clear of the jig and the clearances were therefore marginal. The ring can be seen caught on the clamping screw immediately underneath the drill.

It was found that the return spring on the spindle action was weak, and the drill spindle was also in regaining its upper position; indeed the operator had consists it. The data this settler spring in good and efficient order. But it is equally important that persons avoid the wearing of rings when engaged in such constants as these constants are the constant of the constant in t

It will be noted that the drill itself was not guarded. The guarding of drills was dealt with on page 8, Volume 16 of this Series.

25. STRIPPED BY BORING BAR

An academt at a horizontal boring machine illustrates the danger, which should be well known by everyone concerned with machinery, of projecting both beads, set screws and similar fittings on revolving parts of machines. The machine operator, a skilled man responsible for his own setting up, was using the machine with an extension bar in the boring spindle; this bar was secured by a projecting gatu dold. The operator was rackingly over the revolving bar to adjust the acid pipe when his overall alever was caught on the projecting both and his entire docling, except for his bots and socks, and storn off alls body. fatal. The lower photograph facing page 25 shows the projecting stud bolt and some of the clothing.

The projecting boit on the boring bar could have been replaced by a sunken screw. While this would have been a wise precaution, it must be remembered that the risk of clothing being caught does not arise only with projections but that a smooth revolving bar may cause serious injury due to a loose end of clothing wrangoing round it.

Cranes

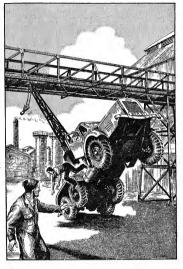
26. CRANE IN COLLISION WITH OVERHEAD STRUCTURE

The driver of a travelling jib crane was fortunate to escape with only a few bruises when he jumped from the cab as the crane rearred up and fell over on to its side. The jib head had collided with an overhead bridge carrying a steam pipe between two buildings. (See illustration opposite).

The crane was travelling with the jib at minimum radius so that the driver was unable to keep the jib head and the road ahead under observation at the same time. A too ready assumption that the crane would clear the pipe girders was responsible for this potentially serious accident.

was responsible for this potentially serious accident.

This is not an isolated instance of this type of accident. Sometimes the overhead obstruction comprises bare conductors of electricity whereupon the



danger attendant on overturning is added to by the further danger of electric shook due to the metal structure of the crane becoming electrically charged. In the case of a rubber tyred vehicle, any person standing upon the ground and touching the crane would be liable to receive severe injury due to shock.

Accidents of this type were referred to in Volume 14, page 28 and Volume 15, page 13 of this publication.

When driving a crane under circumstances in which the load and all parts are not under the continuous observation of the driver then, unless a previously rehearsed movement is being executed, a signaller or look-out man should be made responsible for directing the movements of the driver.

Woodworking Machinery

27. DANGEROUS ADAPTATION OF A MACHINE

A considerable amount of edge anding had to be done in a woodworking factory which did not include a disc anding machine among its equipment. There was, however, a hand turning lathe which, in addition to a small face plate for use when working between centres, had an outside face plate approximately 12 inches in dismeter, for turning large diameter work. The outside respective to the plate was adapted for sandire the plate was adapted for sandired to the plate was adapted for sandired to the plate which was adapted for the plate when the plate was a diameter and fixed to the face plate by four wood screw, the heads of which located in counter sinkings in the back of the face plate. A head to display the plate was a small of the sanding work was completed, no further use was made of the sanding disbut it was not removed from the face plate.

Some months later, when the smaller face plate and centres were being used, the wooden sanding disc broke and flew off the face plate, one part striking the operator of the lathe and causing severe injuries. It was found that the disc had broken into three parts, the lines of cleavage either passing through a screw hole and along the grain of the wood or along the line of the glued joint. The timber was straight grained and of good quality. Two of the holding screws had sheared, the screw ends remaining in the disc, but the other two screws had pulled out. All the screw holes were considerably elongated, showing that the screws had been subjected to considerable stress probably as a result of torque on the disc. The glass paper was in bad condition, being worn quite smooth and having dark brown areas which could have been caused by workpieces charring slightly under heavy pressure. There seemed to be no doubt that the disruption was the final result of progressive deterioration over a period which started when the disc was first used for sanding. The pressure exerted on the workpieces could impose a considerable resistance to the drive. particularly if the pressure was applied near the periphery of the disc. This resistance could only be transmitted through the four screws, and would tend to split the wood along the grain and elongate the screw holes. The deterioration had not progressed to a critical point when the sanding work finished and, since the screw heads were buried into the counter-sinkings, visual examination would not reveal any defect. Nevertheless, the inertia forces, which operated every time the machine was started or stopped, would aggravate the position until, at the time of the accident, a position of instability was reached and the disc disrupted.

An adaptation of this type is essentially unsafe, due to the impossibility of providing adequate fixings for a disc of this nature. Whilst such fixings are

standard for face turning, they should only be in use whilst a single piece is being turned and should not be relied on to hold material over a considerable period. The only safe way of adapting a machine for work of this sort is to have the necessary abrasive material bonded to the face plate either directly or was a packing such as thin felt.

Building Design

28. CUT BY GLASS DOOR PANEL

In Volume 16, Item 12, attention was drawn to the possibility of preventing certain types of accident in the occurrence of which the constructional features or equipment of a building play an important part such that if the risk is



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foreseen by the designer, such accidents may be provided against. Risks particularly mentioned were those due to poor natural lighting of passages and stairs, unprotected glazing on suits and landings and lack of proper anchorages in the roof or at the top of walls for the suspension of cradles or light suspended scaffolds.

Three recent accidents have again drawn attention to the danger of window gas a positioned to that persons are liable to come in forceful contact with it. In all three cases the injured persons punhed a glass door panel with their hands in order to open the door (see Blustration on page 59). In each case the hand and arm injuries were severe, this being specially to where a swing door was enroyled, at the door revung back allowing the twother panel to infinite further enroyled, and the force revung back allowing the twother panel to infinite further.

Glass in door panels, if liable to be broken through contact with a person, should either be protected or be of such construction, e.g., wired, that it cannot be shattered.

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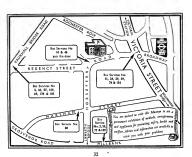
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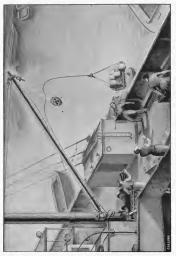
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Fatal Shock from Portable Blower (see opposite page)



Divined impage distlicted by the University of Paythometer Library Distlication

Use of Fork Lift Truck (see opposite page



Ring Causes Loss of Finger (see opposite page)



Stripped by Boring Bar (see page 26)

ACCIDENTS

How they happen and HOW TO PREVENT THEM

Descriptions of Certain Accidents Notified to H.M. Inspectors of Factories

Published Quarterly
VOLUME 24 (NEW SERIES)
July, 1955

ISSUED BY THE FACTORY DEPARTMENT
MINISTRY OF LABOUR AND NATIONAL SERVICE

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LONDON: HER MAJESTY'S STATIONERY OFFICE



VOL. 24

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FOREWORD

To facilitate easy reference to the particular types of accident or risk which have been described in this Series, an index was issued with Folume 12 covering the items described in Volumes 1 to 12. With this volume as a separate inset is an index for Volumes 13 to 24 we but there is now available to readers a complete index for the twenty four volumes so far issued in the new (Post War) Series.

Metal Scaffolding

From time to time information has been given in this publication about accident on scaffolds which are either fally or used in a manner which has not been anticipated. On page 25 of this issue the fullure of an apparently good putting scaffold is described. A recently publicated leafler! on "Metal Scaffolding" is intended mainly to help the small builder who prefers to erect his own or hird components. It deads with simple types of putting and inor four toroys in hight. It gives blant on choice of material, spacing of the
various members, methods of erection and if its recommendations are carried
out it should lead to greater safety. An earlier leaflet's in the same series dealt
with the maintenance of scaffold boards, tubes and fittings.

Timber Ladders, Steps and Trestles

Accidents due to the collapse of ladders have been described from time to time in this published. In many cases the ladders involved in accidents are of faulty construction or made of unsultable materials. A recently revised and gives minimum requirements for components considered to need definite specification in order to ensure sound manufacture and construction, but without unduly vertexiteding manufacturers in their designs. Their products must, however, comply with the tests specified in the appendices. It has been facture and as far as possible they have been included as a ilernatives.

The tests specified are intended for easy application, by manufacturer or purchaser, as a check on the suitability of new ladders, steps and trestles. The species of timber to be used for stiles and rungs are listed, while defects which discualify the use of timber in manufacture are given.

The Standard draws attention to the fact that metal fittings and tensioning cables render a wooden ladder electrically conductive. Suitable presuntions should always be taken when using ladders in the vicinity of electrical equipment, especially overhead cables, which is normally out of reach. The danger of electric slow from wooden ladders was mentioned in these passes only recently.

Correction

Volume 22 (January, 1955), page 9. For heading "Laundries" read "Hydro-Extractors".

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Ministry of Works Advisory Leaflet No. 36-1954—H.M. Stationery Office, price 3d. 2 Ministry of Works Advisory Leaflet No. 22—H.M. Stationery Office, price 3d. 2 B.S.1129; 1954—British Standards Institution. 2. Park Street, Loadon. W.

INDUSTRIAL ACCIDENTS

VOLUME 24 (NEW SERIES)

The description of accidents and accompanying illustrations or diagrams in this publication are intended only for future guidance in safety matters and not to convey implications as to the extent, I any, to which particular individuals or firms may have been to blants in connection with the accidents

Woodworking Machinery

1. DANGEROUS USE OF A CIRCULAR SAW

A maintenance man of long experience wanted to cut a narrow slot in the face of a piece of booth /1 fins. long. 1 in thick and tapering in width from 2 β in to 4 ins. The 80t, which was to penetrate the thickness of the wood parallel from the piece of the wood parallel from one end and 2β ins. from the other. He decided to 0 the work γ is "dropping-on" to a circular saw after removing the top guard and the riving killer and gallwaine the table to that the saw projected only $\frac{1}{N}$ of an inches when the saw the saw of the saw that the same that the saw that the same projected content with the saw the saw the saw the wood back and his left hand was hadly injured when it came into contact with the saw tent).

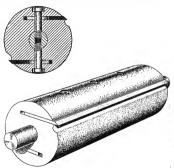
The only machine which can safely be used for this work is a jig saw, otherwise safely can be saved only if the work id none by hand. If none of the more common machines has to be used, then a vertical spindle moulder is less likely to cause injury than a circular saw hat, since saw cutters on spindle moulders are also ishale to "snatch" when dropping on, a holder equipped with proper bandles is used for the workpice, in conjunction with a back too firmly find either to be table or the fence. A "snatch" or a "throw back" by cutters is usually monitor to be a source of the state of

2. DANGERS OF OVERLOADING MACHINES

Although the louding imposed on a woodworking machine varies considerably with the size and nature of the wood being machined together with the depth of our and the condition of the cutters, a modern production machine is usually made to withstand conditized no evolucialty, provided therefore, that a purchase selects a machine to accommodate the largest size of stock which he may wish reduce the selection of th

Numbers of small machines are sold to be mounted on work benches; their construction is much less robust than that of the general run of heavier machines designed to be secured to floors. The larger sizes of these small machines are suitable for light production work but the smaller sizes cannot safely be used for anything but work of the lightest nature.

They are, in effect, labour saving devices for anateur woodworkers and should not be called upon to do heavier work than can be done by a haud 100. Nevertheless their low cost is a very attractive feature and cases have been known of their being used in factories on work far in excess of their true capacity. Unfortunately, persons who will use machines in this way are not likely to be bed in the contractive of the contractive will be magnified by inefficient outers.



This state of affairs is exemplified by the following incident:-

An undertaker hought a planing mushine with a cutter block 6 inches long, designed for mounting on a bench and put it to work to plane elm coffile boards. There was no electric power in his workshop and he used as motive power a small petroll engine of unknown speed. Immediately after starting up one morning, and before any wood had been planed on that day, one of the knives of the plane of t

It was latter found that the 2½ ins. diameter single piece vicealer cutter block was made of a light alloy, and was menuted on a steel plotted; ins. distances. The kniews were located in also it jims. deep and one hundredth of an inch wider than the thickness of the knives (in). The arrangements for securing the knies to consisted of three jims. Allen serow which extended from counterbored sockets in the surface of the block through the knies is used and the remaining access in the surface of the block through the knies also and the remaining tutton opposite). The knies when any pub their in the steel spindle feer illustration opposite. The knies when any pub the size is such as the consistency of the blocks under pressure from the access and the gripming area would therefore be limited to a line just behind the knife bewel. This simple and cheap method of kniff mounting can be used only with relatively soft and clutch motal and, since the mean is deformed to grip the cutter, the opposite the cutting operation. So are read to Patametric by the kniteries in the course of the cutting operation.

The knives were found to be in poor condition. The one which broke had been ground down considerably and one end had been reduced in width much more than the other, i.e. the cutting edge had not been maintained square. In addition the knife was blunt and the back of the cutting edge was curved in section instead of showing grinding and honing bevels.

No information could be obtained about the depth of cut. This depth is of considerable importance in conjunction with the speed of feeding where such notoriously difficult cross grained timber as elm is being worked, as in this case.

Summing up, this miniature machine driven at an unknown speed had been

Summing up, this miniature machine driven at an unknown speed had been used with inefficient cutters on work which properly required a heavy production planer. As a result of abuse one of the knife clamping jaws was distorted and allowed the knife to break and fly.

Whilst the inherent dangers of woodworking machines can be minimised by use of guards of the best possible standard, guards cannot be relied upon to give protection against the dangers indicated above, which can be avoided only if persons who buy and operate machines will appreciate and observe the safe limits of performance.

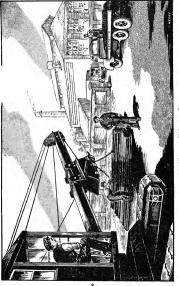
Excavators

3. FALL OF EXCAVATOR JIB

A man was fatally injured when the jib of an excavator unexpectedly fell and struck him. The mackine was rigided as a "skimmer" but was being used to jift struck him. The struck right of the struck right of struck right of

from one of the rails, the jib fell and struck the slinger.

The driver of the machine could not see the man handling the sling because his view was obstructed by the skimmer bucket and as he leaned from his cab to ask his foreman for instructions the jib dropped (see illustration overleaf).



Subsequent examination of the excavator showed no defect in the brake mechanism or in the brake locking device and it appears likely that the driver accidentally released the brake pedal whilst leaning out of the cab having failed to lock it properly beforehand.

The state of the control of the state of the

Controls on modern machines are usually satisfactory, but the following points should be watched for particularly on older machines:—

- Brakes exposed to the weather. When the weather is wet or frosty efficiency is decreased perhaps to a dangerous degree. Protection should be provided.
- 2. No locking davice provided on brake levers or pedals. The rope drum concerned may be held by a brake which has to be locked by a pavl and ratchet which is operated separately from the lever or pedal and is somewhat the pedal of the p

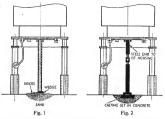
Foundries

4. FAILURE OF PROP UNDER CUPOLA DOOR

A man was standing on a short plank at the bottom of a cupola undergoing repair, whilst the adjacent cupola was blowing. The cupola is hast was about 5 feet in diameter and the bottom was closed by a single circular door, linged of 5 feet in classifier and the bottom was closed by a single circular door, linged could be compared to the control of th

metal, receiving injuries from which he died.

Alterations have now been made in the design of the prop and its fittings (see Fig. 2). A "U" shaped casting has now been set in concrete below the entre of the cupola door, so as to give an adequate and firm base for the prop.



A similar "U" housing has also been fitted to the underside of the cupola door. The tubular prop itself can be fitted with a screwed portion so that a turn or two by means of a toggle bar will extend it sufficiently virtually to jack up the door against the cupola base.

5. CRUSHED BY CORE STOVE ROOF PLATE

A somewhat unusual fatality occurred in a heavy ores rove when one of the roof plates fill on to a man who was standing in the store. The stove was 24 feet long, 18 feet wide and 16 feet high, and the roof was composed of five cant iron T beams supporting stell plates, cane plate weighing 10 owns, and resting on the webs of the T beams. The plates were arranged in rows of three, accords the stove, and one end of the final row of plates rested on the flanges of a T beam while the other end rested on the top of the stove wall. It was the new thind the contract of the store while the contract of the store while the plate of the other works and the store while the plate of the other works of the row tends find, the other two plates of the row tends find, the other two plates of the row tends find, the other two plates of the row tends find, the other two plates of the row tends find, the other two plates of the row tends find, the other two plates of the row tends find, the other two plates of the row tends find, the other two plates of the row tends find, the other two plates of the row tends find, the other two plates of the row tends find, the other two plates of the row tends find, the other two plates of the row tends find, the other two plates of the row tends find, the row tends find the row tends find, the other two plates of the row tends find, the row tends find the row tends find, the row tends find the row

Examination of the stove after the accident showed that spart from being located against the webs of the T beams, the plates had never been scorred in any way and there was no estating in the wall to prevent latteral movement. The two plates which remained in position had a bearing of only about a quarter to half an inch on the webs of the T beam. The stove had been in use for over 30 years and it would appear that the plate which fell us account of the stove during this plant of the stove during the story of the stove during the story of the story during the story of the story during the story

This accident illustrates the need for careful design and construction of any kind of furnace, and also for careful periodical examination of all plant. The roof plates of this core stove had been covered with sand in order to conserve the heat generated in the stove and removal of this would be necessary to enable such roof blates to be examined.

Cranes

6. TRAPPED BY DRAGGED LOAD

A fatal accident occurred in a heavy press shop when a man's legs were cut off owing to a press bed sliding horizontally and trapping him against the edge of

owing to a price seed standing ionizonally and trapping initin against the edge of a pit.

The foundation pit for a heavy press had been prepared and on mounting the machine bed it was found that it did not sit properly on the foundation bolts. The bed was lifted by an overhead travelling crane and placed with its edge just

overlapping one edge of the pit whilst two men began to check the dimensions of the bolts.

The pendant controls of the crane were some eight feet from the load and beyond some material stacked at the edge of the pit.

An apprentice who desired the use of the crane, and unaware that a load was attached, operated the long travel motion and the heavy bed slid forward trapping one of the men; the other man who was standing in the pit escaped without serious injury (see illustration facing page 10).

It is essential, if accidents of this kind are to be avoided, that a responsible present be in charge of a crame with pendate controls, which otherwise tend to be operated by all and smady. In addition it is not in the interests of aftery to be operated by all and smady. In addition it is not in the interests of aftery to the control of the control

Food Machinery

7. MEAT MINCING MACHINES

Two recent accidents on meat mincing machines serve as sharp reminders of the necessity of ensuring that the fencing provided for this highly deaperous type of machine is adequate under all circumstances. In one case, a lad was working an old machine having a bell mouthed feed opening when his hand was trapped by the worm and so multilated and held fast that an emergancy operation had to be performed there and them in the botther's premises to supputes the Véttin's hand at the wrist. In the other case the lad and the again proved necessary. (See illustration opposite). These two particular accidents occurred to boys with small hands, but many adults are injured every year whilst using these machine.

Although mincing machines are more commonly used in sausage factories they are also to be found in other food factories, canteens, etc. The danger is all the greater because it is not slways realised that small handed persons,











Fig. 3

generally accepted standard of fencing for meat mincing machines has been a feed opening not exceeding 21 ins. diameter in the throat situated not less than 5 ins. distance from the worm (Fig. 1) and this holds good to-day. This restricted opening should form an integral

part of the chopper cylinder so that the protection afforded remains permanent even if the feed tray is removed, e.g., for cleaning. In some cases a much larger feed opening is provided in order to provide a higher rate of feed and where this is so, it is necessary to fit an external restriction plate (Fig. 2). Where such an arrangement is adopted, it is essential to ascertain by trial that it positively prevents the fingers reaching the worm. The plate should be of robust construction and it is good practice to fit an additional support "A" (Fig. 3) to ensure that the plate remains rigid because the slightest amount of give or spring upwards can result in a hand being able to enter the

throat sufficiently to reach the

worm.



There are still many old-fashioned machines in use having bell mouthed feed openings. Fig. 4 shows a method of fencing this opening. Generally, however, machines of this type will be so old that users might well consider the advisability of replacement by modern safe machines rather than expend money on those whose useful life is rapidly coming to an end.

In the larger factories, machines may have minding capacities of the order of several tons of ment per hour. The meat is fed into these machines in large pieces and so the provision of guards which will ensure safety without adversely affecting the machine capacity, requires careful consideration. The method affecting the machine capacity, requires careful consideration. The method and the contract of the contr

There is another point of danger which is a prolific cause of sacidents. In general, the worm forces the material along the barrier of the machine whence it passes through a series of rotating knives and fixed cutter plates. The end cutter plate is interchangeable and perforated with many holes, the diameter of these being selected to suit the grade of mines required. In the larger type of machine the holes in this end plate may be suitionely large to permit the entry of a finger the tip of which may be impured by the rotating knives. Thus, the cutting machines without difficults is necessary; if can bunally be fined to existing machines without difficults.

Finally, considerations are underlying of operator is necessary. Investigation of a number of ecidents has revised that a children on eshool buildage for of a number of ecidents has revised that a children on eshool buildage for on Saturday morning lawe been illegally permitted to operate these independent of Saturday morning lawe. The meaning of the control of th

Transport

8 CRUSHED BY FALLING TREE

A tractor drawing a trailer on which five trees were stacked to a height of 10 ft. was driven into a wood yard, the effective width of which had been reduced to about 8 ft. due to other trees being stowed against the wall of the mill building. The clearance, therefore, at either side of the 6 ft. wide trailer, was only about 12 ins.

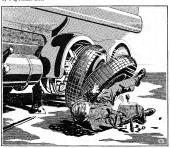
The lashing chains around the trees on the trailer had been released and whilst the tractor driver was standing in the 12 inch space, the yard forement and a lad climbed on to the trailer to measure the topmost tree. This was awkwardly shaped (18 ft. long, about 2 ft. diameter) and weighed about 1 ton. In taking the measurements, the tree was disturbed, and rolled down over the trailer stanchions on to the driver, knocking him to the ground; before the yard crane

could lift the tree off him, he had been so severely crushed that he died the same day.

There are many lessons to be learnt from this occurrence. First, it is had practice to obstruct yards and passage through indiscriminate storage; it being a legal requirement that there shall, so far as is reasonably practiceable, be provided and maintained star means of access to every place at which any person has at any time to work. Seconday, the many discriminated that the provided and maintained star means of the star of the chainst and the star of the chain sing attached to the crane could have been used to steady and hold the tree. Thirdly, it was foolhardy to clamber about on a trailer containing unresulted into succeed trees storage of the other containing tree had not rolled off. Lestly, there was fact of discrive specialising if a tree had not rolled off. Lestly, there was fact of discrive specialising the consequence.

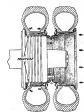
9. WHERLS BLOWN OFF LORRY

A heavy vehicle was driven on to some waste land near the factory where the driver was employed so that the tyres on the twin rear wheels might be replaced by a specialist fitter.



The fitter removed eight of the ten retaining nuts but found the remaining two difficult to turn. Being suspicious about the reason he left the job to obtain a key to deflate the tyres, but during his absence the driver took up the spanner and proceeded to unserve the nuts. He was so occupied when both wheels blew

off with considerable violence, the outer wheel striking him and causing severe injuries (see illustration on opposite page).



away from the other part of the rim, the fracture having the appearance of having existed for some time, and only held in position by its bearing against the flange of the brake drum (see diagram). As the two remaining nuts were unscrewed the pressure within the tyre stripped the last few threads of the holts.

Investigation revealed that the flange of the inner rim had completely broken

The following important points should be noted. The tyre fitter should not have set about the job without first releasing the air from the tyres immediately after jacking up the vehicle. Alternatively he should have replaced some of the retaining nuts before leaving the vehicle to obtain the deflating key at the same time warning the driver of the risk

Electricity

10 UNPROTECTED LAMPHOLDER CAUSES ELECTROCUTION

A director of a small dairy was electrocuted whilst supervising the routine work of emptying and cleaning the liquor tank of a bottle-washing machine.

For local illumination a home-made portable lamp, comprising C.T.S. cable, bakelite lampholder, and 60 watt lamp was used. The lamp was placed over the rim of the galvanised fron liquor tank, but it was not secured and during the operation it slipped and the lighted lamp was immersed in the detergent solution.

The fall and immersion broke the lamp filament and the director removed the fitting by the flex and attempted to remove the lamp from the holder. The conducting liquid caused a short circuit from the live pin of the holder to the brass sleeve and so energised the metal lamp cap. The director received a severe electric shock, since the concrete floor was wet and conducting, and did not recover

The portable lamp was entirely unsatisfactory for such a situation and should have been constructed of insulating material with full enclosure and protection of the metal lamp cap. A further guard should have been provided to protect the lamp itself.

The great potential danger of electric shock from alternating current supplies at mains voltage under such conditions can easily be covered by the use of extra low voltage equipment. Such equipment utilising say 25 volt supplies from double-wound isolating transformers should be used in all places where moisture or restricted working spaces are likely to be met.

11. DANGER OF SHOCK FROM MEASURING TAPE

An extension to an outdoor 132kV. Sub-Station necessitated the erection of pylons, concrete gantries, insulator posts, etc. The usual safety precautions included segregation of safe zones, red and green flagging, earthing, issuing of Permit-to-Work cards, etc.

An electric fitter and his mate were taking measurements, with what appeared to them to be a fabric tage measure, from the tops of three 32 ft. high santries, through short downward curved guide tubes, to the tops of 14 ft. high insulator, through short downward curved guide tubes, to the tops of 14 ft. high insulator tops, to enable the necessary copper down-drop consistent to be made up. to the tops of 14 ft. high insulator to the second top of 14 ft. high insulator to the second top of 14 ft. high insulator to the second top of 14 ft. high insulator to the second top of 14 ft. high insulator to the second top of 14 ft. high insulator to the second top of 14 ft. high insulator to the second top of 14 ft. high insulator to the second top of 14 ft. high insulator to the second top of 14 ft. high insulator to the second to the second top of 14 ft. high insulator to the seco

at the foot of the insulator post and walked towards the gantry 10 ft. away. The fitter had removed his safety bet to descend, and was in the act of withdrawing the tape from the guide tube when he received a severe electric shock from the tape end. Luckily his fall was twice broken by cross members of the gantry. He was fortunate to survive the shock and fall.

A stiffish breeze had pulled out more tape from its case and carried it in an ever widening are towards the live 132kV. conductors 18 ft. away, flashover eventually taking place.

eventually taking place.

Although there was no indication on the tape or case, the tape was reinforced with fine copper wires, an arrangement which, although common to the better

class of tape, may not always be appreciated by persons using them.

12. FATALITY CAUSED BY DEFECTIVE CONNECTION

A handyman labourer was given the job of connecting up a portable drill so that it could be used outside the factory. This involved joining two extension cables by the all too common procedure of twisting the wires together and bandaging them with black tape. This long lend trailed right across the works and over a "tram" track outside. During the course of the day there was a movement of workpopele over the lead both inside and outside the works and there can be little doubt that immediately prior to the accident someone strained to the consistence of the control and earth wires to be pulled free and found the consistence of the control and earth wires to be pulled free and found to the consistence of the

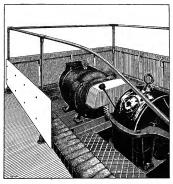
Prompt as his effort had been the unfortunate victim failed to revive although artificial respiration was applied and a doctor arrived within fifteen minutes.

Every joint and connection should be well made and should have at least the same properties in regard to mechanical strength, insulation, conductivity and protection as those of the circuit of which they form part. Joints formed by

Transmission Machinery

TRAPPED BY GEARWHEELS

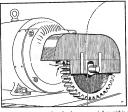
The illustration on this page shows the arrangement of the motor and gearwheels driving a drier in a sulphate of ammonia processing plant. The motor and its gearing were accommodated in a pit which had been made originally for a steam



engine. The pit was railed as shown and the motor gearing was partially covered by a sheet metal casing, which, unfortunately, left the inrunning "nip" exposed as shown in the illustration overleaf.

The floor above was swilled down with a hose pipe three times a day and some liquid (with dissolved salt) seeped through and dripped on to the motors and gearwheels, leaving a coating of salt. It was the custom to clean the motor, gearing, etc., three times a day and for this purpose a workman went inside the railings and with waste cleaned on the various parts. One day a worker was

cleaning as described when an end of the waste was snatched by the "nip" of the gearwheels. His hand was drawn in to the "nip" and he sustained injuries involving amputation and mutilation.



The management was aware that cleaning was carried on within the railed enclosures when the machinery was in motion, and notwithstanding the proximity of the unfenced "nip" supposed the gearwheels to be fully guarded.

It cannot be stressed too often that there is only one effective method of guarding gearwheels, and that is by complete encasement.

Machine Tools

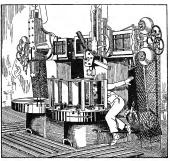
14. ACCIDENT DUE TO LACK OF MAINTENANCE

It is well known that if proper steps are not taken to ensure regular maintenance of power pars mechanism, brackdown leading to serious accidents, may take place. Such a case is one where an operator lost parts of both hands when a press commenced to repeat continuously. At the time there was no guard on the press both the circumstance which led to the accident was the ineffective operation of the extractor. Owing to stakening of our of the securing must on the extractor of the critical or the contractor of the discipation on the fly wheel and was 10 prevented from returning to the discipating region of the conditions whereby it was possible for the press to be put to work without an effective guard being in position. Sound maintenance arrangements for each he nesfected with immusity. Care in the way of regular inspection of exposed as the nest he nesfected with immusity. Care in the way of regular inspection of exposed

parts together with thorough examination at intervals of say, six months, to ensure that all hidden working parts are in good working order is most important. The maintenance of presses and guards was previously referred to in Vol. 17 of this Series (page 19).

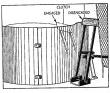
15. FATAL ACCIDENT AT BORING MILL

A boring mill which had been in use in a factory for thirty-three years had been operated throughout that time by the same man. He was killed at this machine in the following circumstances.



The job consisted of turning internal parts of a casing, as indicated in the intustration above. At the time he was setting up the job, and was probably making the final adjustments and examination to see that all was seft to begin machining. While the table was revolving at about 11 r.pm. it would appear that some projecting part of the catange, or of the clamps quantity of the case of the clamps of the

Following the accident an addition was made to the clutch control in the form of a frame placed in the probable path of anyone who should be eaught by a moving part (see illustration below). Contact with this frame would cause it to move the control gear so that the clutch is disengated. While this might reduce the risk of serious accident, it has to be borned in mind that there is considerable inertia in the verwolving parts of a horing mill, and there may still be sufficient movement to drag part of a horing mill, and there may still be sufficient movement to drag part of a horing mill, and there may still be sufficient movement to drag part of a horing mill, and there may still be sufficient movement to drag part of a horing mill, and there may still be sufficient movement to drag part of a horizontal part of the part o



In Vol. 4, Item 13 of this Series reference was made to another type of accident which occurs occasionally on these machines, i.e., release of work from the chuck due to bad clamping or other factors associated with the work mounting. The following instructions, quoted by the courtery of a firm of machine manufacturers from their instruction book, indicates the kind of pressutions that ought to be taken:—

"It is always essential to ensure that castings or forgings are held as firmly and as rigidly as possible since the heavy cuts that can be taken will exert considerable pressure on the workpiece.

"Elementary precautions to be observed are that castings and forgings should not he gripped on tapering diameters with parallel jaws unless some additional means of support is available, or if gripped in this manner care should be taken to avoid using heavy feeds.

"The gripping of many components can be assisted by judicious clamping, but this clamping should always he immediately over stops which aid vertical location. In general it should be considered bad practice to clamp any component at all when it compared by unposted immediately below the clamp.

location. In general it should be considered bad practice to clamp any component at all when it cannot he supported immediately below the clamp. "A further point regarding the gripping of workpieces with jaws is that if the job is gripped on the outside diameter and hecomes heated during

machining the strength of the law grip will increase.

"On the other hand, when a component, for example a large ring, is gripped inside with jaws the heating up will cause the job to slacken and if a considerable amount of heavy work is to be carried out it is essential to re-tighten the chuck jaws to avoid the job moying."

16. ACCIDENT AT LATHE

A boy of 17 was working at a lathe in an Apprentice School. He was being aughly how to use the machine by monther apprentice, and while standing by the machine he insiderettedly put his index finger through the spokes of the handwhede on the end of the feed shaft. The feed shaft was revolving and the handwhede on the end of the feed shaft. The feed shaft was revolving and the training of the shaft of the shaft better that he had. Open-spoke wheels on machine tools revolving under power have been known to cause other accidents in this way, and solid construction is preferable. Alternatively, a different form of construction as explicit, and can only be connected to the shaft by engaging the teeth of a simple dog engagement with the shaft, operation by power cannot be obtained. References to this subject may be found in the "Second Report of the Committee on the Safeguarding of Milling Machines" (ages 37)*.

Hoists and Lifts

17. FAILURE OF BUILDER'S TYPE HOIST

Castilever platform hoists are primarily intended for use on building and similar work of a temporary kind and should be used only in circumstances where the double guided type of permanent hoist is either not practicable or appropriate. The attempt described below to adapt a builder's hoist for permanent use in a factory resulted in a dangerous occurrence which might have had graver consecuences than, in fact, it did.

The hoist was eracted at the open and of a building housing chemical plant, and certain modifications, such as the provision of hoistway gates, were carried out in an attempt to comply with Section 22 of the Pactories Act, 1937. A major alteration was the replacement of the 10 ext. capacity friction winch by a one ton capacity reversible which with a 3½ h.p. motor fitted with a current overload device.

The hoist was being used to carry two barrels from the ground to the upper floor. The chargedand operating the hoist loaded the barrels on to the platform, closed the gates, and climbed the outside staits to await the arrival of the platmental three plates, and climbed the outside staits to await the survival of the platform carend the top landing level one or both of the barrels founded the underside of a projecting landing plate, which had been fitted to close the gap between the edge of the handing and the platform. As the top limit switch had not yet been reached, the winch continued to wind, and before the overload device could be provided to the platform of the must allowed the platform rollers to leave their books. The distortion of the must allowed the platform rollers to leave their

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^{*}H.M. Stationery Office, price 3s. 6d.

guides, so that the arrestor gear became inoperative, and the loaded platform fell to the hottom of the hoistway.

The failure was due to severe overloading of the head gear at the top of the mast to which both the hoist rope sheave and the dead end of the rope were secured. The breaking load of the rope in use was 3.4 toms hut, as the pulls from three parts of the rope were applied to the head gear, the loading on the mast at the moment of failure was probably in the region of 10 toms.

Had the original friction winch been in use, it would have been difficult to supply a server excess load as either the friction pinion would also or the use to supply a server excess load as either the friction pinion would also or the use to excite the motor made the latter indicates in the operation of the overtoad device on the motor made the latter indicates in the operation of the overtoad device on the motor made the latter indicates on the operating through a considerable enduction gear to obtain a slew rule or samely operating through a considerable round to obtain a slew rule or samely operating through a considerable round for the obtain a slew rule and the same through a considerable round for which we have a supplied to the same through the short of the other operations are supplied to the same through the same through the supplied to the same through the same through the same through the work for which it was not designed, alternation were made which created indicates unforestern by the first's supplied in the same through the same way to the same through through through the same through through the same through th

Steam Plant

18. EXPLOSION FROM FLEXIBLE STEAM PIPE

A man was killed when he was struck on the head by a brass coupling which had connected the ends of two fucilité setam pipes. The pipes were made of copper strip coiled into a spiral, the edge of the strip being turned over to form an interlock with adjacent coils and absentso cord inserted between the coils to ensure steam tightness. The spirals formed a thread on the outside and brass couplings were screwed on and secured by packing and gland nuts.

The pipe was used to convey steam from a vertical boiler to an engine driven which and the accident occurred whilst the winch was their guest for pile driven. There had apparently been no indication of leakage from the joint which suddenly failed when the length connected to the winch lakes out of the brass coupling and the portion connected to the violate stop when space for the coupling and the portion connected to the boiler stop when space for the present substitution operation. The present such as the present such a

The failure of the pipe appeared to be due to the unservoing of the coupling tail piece from the pipe. There would be a tendency seek time the coupling was disconnected for the tail piece to unserve slightly unless the pressure was taken of preventing rotation of the whole coupling by using a second spanner, there heing no other means of preventing rotation of the stall piece on the pipe. This pressurion had not always been aftern and cerentally there was insufficient thread engaged to retain the pipe end in the tail piece when under seam pressure.

scan pressure.

It is essential with this type of joint that proper care be taken when tightening and unscrewing the couplings to ensure that the tail pieces are not rotated on the pipe ends. Furthermore, couplings and pipe ends should be regularly inspected by someone who understands their construction to make sure that they are in a satisfactory condition.

Building and Constructional Work

19. COLLAPSE OF STRUCTURES

Reports of accidents due to the collapse of structures during some temporary state of weakness or instability in the course of rection suggest that there is at times insufficient appreciation of the need to provide support by guys, stays, or other fittings during such periods. Three instances are quoted, presenting different circumstances in each case but pointing to similar faults of omission or commission.

One man was killed and two others slightly injured when the gable end of a bungalow, then in course of erection, collapsed and demoished an adjoining garage in which the men were sheltering from the weather (see illustration opposite). The erection of the garage teller flat been completed some three days before the accident and the shuttering supporting the flat reinforced concrete was the contract of the contr

On the day of the accident the men had intended to go on with the enection and feiting of the roof timbers but, because of a further deterioration in the weather which had been bad for several days, they were forced to abundous conside work and seed shelter in the completed garage. A high and guity wind considered the seed the completed garage. A high and guity wind the consideration of the gable and without warning the freshly constructed wall collapsed and to fit the gable and without warning the freshly constructed wall collapsed and so in turn collapsed on not be made as unable to withstand the impact and so in turn collapsed on not be made.

No criticism could be made of the design or of the materials used in the construction of the building, but there was a failure to realize the weaknesses which are inherent in any newly exceed structure. In this case these were aggrenated by these wite water, which had delayed the drying out of the mortar, aggrenated by the even without the delayed the drying out of the mortar, by the provision of shoring or strutting for the gable end in view of the weather conditions, and another contributory factor was the premature removal of the shuttering supporting the garage roof. Had the shuttering been in position the distriction of the shuttering been in position the support of the shuttering been in position that the support of the shuttering been in position that the support of the shuttering been in position that the support of the shuttering been in position that the support of the shuttering been in position that the support of the shuttering been in position that the support of the shuttering been in position that the support of the shuttering been in position that the support of the shuttering been in position that the support of the shuttering been in position that the support of the shuttering been in position that the support of the shuttering been in position that the support of the shuttering been in position that the support of the shuttering been in the support of the shuttering been in the support of the support of the shuttering been in the support of the su

In the second case a man was severely injured during the erection of a timber funded building. Two Bellast type timber roof trusses had been creected, using a 26 ft. wooden erection mast and a winch. Instead of nowing the erection mast and a winch. Instead of nowing the erection mast and a winch. Instead of nowing the erection mast been kept in the asset possible to the truss about to be erected, the mast had been kept in the same position of the trusses for the benefit of the trusses for the benefit of the trusses when the benefit of the trusses when the world formed the mast some 7.6 ft. 6 mic. over each uncertedd truss in turn is order to creet it in a new position. The first two trusses were fixed to their stanchions by steel mast some 7.6 ft. 6 mic. over each uncertedd truss in turn is order to creet it in a new position. The first two trusses were fixed to their stanchions by steel argap and were connected together by a number of putting, while a 4 fins. × 2 ms. batton, 26 ft. long, was mailed to the crown of each truss and ran obliquely 2 ms. 1 fins to the creek of the presence of the presence

deal was mailed across the two main itse of the exceled trasses and the top of the mast was lowered on to this while the haze of the mast, fasteand to a such colley, was more into the next key. The injured person then climbed a ladder to the mast from the deal on which it rested, it heing the intention after removing the deal, to lower the mast below the main ties and to swing it into the next hay. The mast would then be ready for exection by the which preparatory to raising the next truss. As the mast was raised from the deal, and is well taken by the pulley block the trusses collapsed and the man was thrown to the ground.

good with the method adopted to move the mast was harardous in the current. The which of the mass was sufficient to path the trusses over or to break the purities if it fill against them and hy mounting it on a trolley to fineliate movement, the risk of its getting out of control was sustinantially increased. The trusses themselves were of such a size and weight that the two steel straips which they were fastened to the columns had very little effect on their statistic, and the purities had little restraining effect since they defer the other statistics and supplied out quite this outport their own weight. The thrust exercise the them are the statistically and the purities are the statistically as the statistic of the statistic product of the purities are its weight was raised from the plank and transferred to the purities will replace the statistic properties of the purities will restrict the statistic properties are the statistic production.

The men concerned did not appreciate the risks they were taking, probably because they had done similar sort of work before without anything untoward happening. It is essential that operations of this nature should be under the control and supervision of a person competent both to assess the risks and to decide on the measures necessary to ensure safety.

The third case concerns the collapse of pre-cast concrete columns and timber confortuses errected for a bloes of nor predishizated lauguless of a common type. The framework of the first pair of bungalows was complete, and the creation of the emembers for the second pair neuring completion, when it was realised that insufficient. It is a substitute of the confortunation of the confortunation of the second pair a stempt own gas and re-erecting the framework of the second pair an attempt was made to man-handle each unit, consisting of two columns and a roof trust, by stages through a distance of 1 h. 3 his. Willie this was being done and coincident with an exceptionally strong goal of wind the framework of the first pair of hungalows collapsed first, causing the framework of the second pair also to collapse injuries governi men.

The contractors had departed from the erection instructions supplied by the architects in an essential detail, in that the floor slab concrete had not heen poured for the first pair of bungalows before the framework for the second pair was proceeded with. The concrete columns were of small has are and not fixed in position by any form of anchor holt, so that the framework was far from being stable against the effect of externally applied forces.

The carliest possible steps should always be taken to ensure the stability of structure in course of excelon, and where prelabricated buildings are concerned the exection instructions should be closely followed. An additional factor in the last mentioned collapse was the insedequate structing and supporting, hoth internally and longitudinally, of the framework of the finagenting and supporting, hoth internally and longitudinally, of the framework of the finagent procurious to revent collapse of single-storey huldings under construction are contained in

a " Memorandum on the Construction of Single Storey Buildings with suggested precautions to prevent collapse during crection ".*

20. COLLAPSE OF TIMBER ROOF TRUSSES

A fatal accident recently occured due to the collapse of the timber roof members of a large shed during demolition.

The roof was constructed of 19 Belfast trusses at 5 ft. 10 ins, centres with a span of 65 ft. and the trusses were supported by and strapped to compound steel girders. After the sheeting had been stripped from the roof the workmen proceeded to remove the nailed purlins which were in lengths each spanning either three or four trusses. There were 22 purlins in all and it was the intention to leave two purlins at the hottom of the trusses on the east side of the roof. the 11 purlins on the west side remaining undisturbed, and then to demolish all the trusses together hy rigging a rope and tackle and using a motor lorry to exert a pull.

The men had removed the nine purlins from ahout two-thirds of the length of the east side of the roof when, without warning, the trusses collapsed along their length. An unsuccessful attempt to collapse the trusses by a pull from the motor lorry at an earlier stage in the process of dismantling had proved mencessful

Other factors which may have contributed to the collapse were:-

(a) Wind pressure on the end truss, which was hoarded down to eaves' level.

- (b) Attempts to lever off purlins spanning several trusses by forcing up the purlin at one end.
- (c) Thrust from an access ladder, or from timber already demolished which was left leaning against one of the trusses.
- (d) The haphazard removal of the purlins so as to weaken the building so that it could be pulled down as a whole.

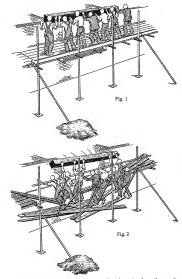
It is noteworthy that the collapse occurred unexpectedly after efforts to pull the trusses over forcibly had failed. Roofing of this type is not properly stable unless there is hracing between some of the trusses or unless the roof sheeting is fixed in position. In this case there was no such hracing and stability depended on the roof sheeting. The fixings between the purlins and the trusses would have only a limited effect on stability, which would be overcome once the trusses had started to move. Some form of temporary struts or hracing should have been provided before the roof sheets were stripped and demolition should have proceeded in a controlled fashion, in this case truss by truss. Attempts to demolish conventional huildings in wholesale fashion is always an unsafe procedure.

21. FAILURE OF PUTLOG SCAFFOLD

Accidents continue to happen because of the failure of apparently good scaffolds. One cause is that the scaffold is used for work or in a manner which those responsible for its erection have not anticipated. A typical instance of this happened during the crection of a pair of houses when three men were severely

injured in consequence of the collapse of a working platform. The scaffold had been erected to first floor height and was typical of a standard seaffold for bricklaving except that rakers attached to each third standard and 25

^{*}Factory Form No. 1998-H.M. Stationery Office, price 3d.



resting on the ground had been provided in lieu of securing the putlogs on the inside of the wall. A concrete lintel beam, approximate weight 7 cwts, had to be placed on the house wall and this was manhandled from a lorry on to the

scaffold where it was being lifted by seven men on to the wall (see Fig. 1 on opposite page.) The men were puthing the beam into position when the scaffold collapsed, their combined effort had puthed the putlege out of the wall. Not only were the rainers intendequetely bededed in the ground (one rested on a loose heap where the rest of the put of the rest of the r

Where beams or heavy concrete lintels are to be manoeuvred on a bricklayer's senffold sizishle precusations must be taken to prevent he excitfold moving away from the building due to forces which may he exerted in positioning the beam. The scaffold should be sufficiently stretted or tied into the building to ensure stability (Regulation 12 of the Building Regulations' requires it to be rigidly about the strends for the purpose for which it is used (Regulation 7), on and adocusted strends for the purpose for which it is used (Regulation 7).

Where putlogs have one end supported by a wall it is essential to ensure that the flat supporting surface is of sufficient area (Regulation 10(3)). Too often the supported putlog end has such a small bearing on the wall that a comparatively slight movement of the scaffold displaces the putlog. Putlog ends should he bedded well home into the wall with the flats in the horizontal position.

22. FAILURE OF CRAB WINCH

A workman was fatally injured when a 10 cwt. hand operated crah winch failed whilst being used to lift a rolled steel joist, weighing about 4½ cwts., into position in the steel framework of a building.

The joist had been lifted by the winch to a height of about 35 ft. and was being held there whilst it was bolted to other steelwork when the winch rope ran out and, as the joist fell, the man who was doing the holting lost his balance and fell to the ground.

The two men at the winch were holding on to the handles and these did not move but although they were in gear with the drum the latter turned and allowed the load to fall.

The drum, as is common on most winches, had dogs in one end which engages with the main spur wheel and the two were held in engagement it woeged surprise between the drum and a square section of the shaft and also by the side plates of the winch frame. Examination after the accident showed that the wedges were looks and were so badly shaped that they could not be driven in so as to secure the drum on the shaft. In addition the dogs between the drum and spur wheel were rounded and worn so that any turning force tended to force them out of engagement. Marks showed that the dogs had in fact richen over each

other. The winch was fitted with a pawl and ratelet and originally bad a brake hut the men failed to use the former and the band and control pier of the latter than the state of the first part of the state of the state of the hand winches but if well designed they are quite capable of holding and controlling loads within the winch capacity. Efficient brakes are a requirement of Reg. 40(1) of the Bulling (Safety, Haelth and Welfard, Regulations, 1948.

Reg. 40(1) of the Building (Safety, Health and Welfare) Regulations, 1948.* The primary cause of this accident was failure to assemble the winch properly

Office, price 1s. 3d.

when it was overhauled. The wedges should have had a slow enough taper to
*Building (Safety, Health and Welfare) Regulations S.I. 1948 No. 1145—H.M. Stationery

fit properly and they should have been secured in position when driven flush with the drum end, either hy a small weld or hy hammering over the drum metal.

23. DANGEROUS METHOD OF FELLING TREES

A fatal accident of unusual type occurred when a tractor was heing used to uproot some large trees. These were growing on land which was being cleared for a huilding site.

The procedure consisted of placing a wire rope round the tree trunk ahout

half way up. The rope was hitched to a light tractor provided with a winch attachment. The tractor was then driven some distance from the tree and a "spade" lowered from the rear of the tractor and pressed into the ground. This "spade "was in effect a two member inclined strut which provided an anchorage for the tractor eagainst the resistance of the tree.

The rope was wound round the winch drum and the clutch was engaged. This had the effect of pollings the top of the tree wor for a certain distance but without uprooting it. As the resistance of the tree increased, the pull of the winch caused the front of the tractor to rise from the ground and at this stage was the contract of the

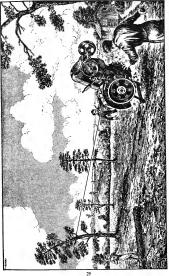
Although several trees had been uproored by this method it was undoubtedly a very dangerous one. As the front wheels of the trator rose from the ground on each occasion the estimate is fortified to the pull of the tree propositively determent the higher its centre of gravity was raised and it was only by the traction of the pull of the pull

Gassing

24. EXHAUST BUMES FROM PETROL ENGINE

Despite the number of gassing accidents that have already heen caused by the exhaust fumes from petrol engines, the seriousness of this dianger is still not sufficiently widely recognised. A recent accident, costing the life of a hoy of 16, emphasizes once again how easily and quickly a dangerous concentration of carbon monoxide can he huilt up by the discharge of exhaust gases into a restricted space.

A firm of agricultural engineers was called in to clean out a well. An engineer and an apprentice went out to de the job, taking with them a centrifugal pump driven by a 1½. HP. engine. They found the well to be shout 30 feet deep, and as the suction pipe on the pump was only 20 feet long, the engineer decided to sling the pump in a rope and lower if the necessary 10 feet down the well. He



started the engine, lowered the pump down the well, and then went down to check the position of the suction pipe and to speed up the engine. Thereafter, he remembered no more until he awoke in hospital, but he had in fact elimbed out of the well, and had made his way, bewildered, to a nearly bouse, where he complained of feeling nurell. Meantime, the absence of the boy caused with the control of the state of the state

which is the control to the control

When pumping is done from a depth of less than 20-25 feet, the engine and pump can be keep ta ground level, pumping by suction. Where pumping is from a greater depth, as is frequently the case for example in a well, or in the hold of a hip, or in a deep exacuation at a building six, the pump must of needs to be lowated to within 20-25 feet of the water level; the exhaust funes can then be led outside by mass of facility leping. A better counts in each circumstances may be to use a submersible pump driven electrically or by one of the state of the manner of the country o

25. OVERHEAD CRANE FRACTURES GAS MAIN

At a steel rolling mill, the final operations of levelling, shearing, and pucking the sheets are carried on in the "warchous", a building about 250 yards long, served by three overhead travelling cranes. At the west end of this building two producer gas mains 18 inches in diameter come down through the roof and pass along, above the crane track, to the adjoining department, in which are close annealing furnaces.

The warehouse floor had become crowded with stored sheets, and the workers, seeking all available free space, moved down to the west end. The east and middle cranes, which normally do not work at the west end, were moved down, to be moved down, to be supported that the middle crane travelled down with its crist as it setterme end of the gantry. The crab on this crane is larger than the one that currently moving in the east end, and the eye-bolt on loop of the mover found the case of the control o

The stops on the crab travel of this crane have been altered, and the clearances on all the cranes have been checked, to ensure that a similar accident cannot

*Factory Form 827-H.M. Stationery Office, price 2s. 6d.

on all the cranes have been checked, to ensure that a simular accident cannot again take place.

Process Machinery

26. DANGER ELIMINATED BY IMPROVED METHODS

Careful consideration of machine operations will often lead to improved methods which in addition to eliminating or reducing danger, also save manual effort and increase the efficiency of the machine or of the operation. Unfortunately such action is often neglected until an accident hrings the risk to light in a forcible and unpleasant manner.

A specialized machine for fixing the chairs to railway sleepers consisted sensentially of hydraulic rants to prest the chairs on the sleepers in association with power operated spanners to tighten the securing holts. The sleepers, with the chairs in pacific way, were fed into the machine on an side roller conveyer and, after the chairs had been faced, were pulled out at the other end by hand. To gain the necessary purchase to move the suberger, the man taking-off had to grig gain the necessary normalized to move the suberger, the man taking-off had to grig crushed his thumb. The man had been reset in motion by the machine operator further to tighten one of the bolts recurring the other chair.

After the accident the possibility of devising some form of mechanical cirction was considered and a scheme was evolved whereby a driver toother doller was ast alongside the position occupied by the sleeper when in the machine and two idial rollers were located directly opposition on the other side. The idle rollers were tournaged to move towards the side of the sleeper by a lever action manually operated. When moved, the idle rollerd pressed this eleper against the driver older which in turn propedictly tout of the machine. This addition eliminated to the contract of the side of the sleeper and to exhaulted agant to be fined to reversal account for the randers point.

In addition to removing a hazard, the mechanical ejection eliminated much heavy manual lahour and speeded up the process.

This accident serves to draw attention to a risk which is always likely to arise when two or more persons are working at a machine. Soone or later one of them either carcleasly or inadvertently will start the machine when the other is an a position of danger. Whenever possible only one person should work at a machine but if it is essential to lave more than one, arrangements should every continuous and the continuous continuous and the continuous continuous areas and the continuous areas are continuous areas and the continuous areas are continuous areas are continuous areas are continuous areas a

27. DANGER OF REVOLVING SHAFTS

A shaft one inch in diameter, revolving at 150 r.p.m. provided the drive for conveying bottles through a holde washing machine. It was situated about two feet from the ground beneath an idle roller conveyor which ran alongside the machine and, when the machine was at work, ded plates were suspended from the conveyor frame so that the shaft was for the most part endosed. At the end of the working week the machine and the surrounding flow were cleaned, the machine being set in motion to run through a destrepent solution of the machine being set in motion to run through a destrepent solution of the machine being set in motion to run through a destrepent solution of the machine being set in motion to run through a destrepent solution of the machine being set in motion to run through a destrepent solution of the machine being set in motion to run through a destrepent solution. As a woman was stooping under the conveyor to hose down the floor beneath the machine her hair was caught by the shaft. A workmate who saw the incident switched off the driving motor immediately, but the woman had sustained head injuries before the shaft could come to rest (see illustration below).



Although there is a wide appreciation of the dangers of revolving shafts, all too frequently the safegards provided are inadequate. In the case in point the side plates were loosely suspended from the conveyor frame and could not be regarded as providing secure feeding. In any event they had to be removed entirely on every occasion when the necessities of cleaning made approach to the running shaft extremely likely.

The shaft should have been completely encased either by means of a fixed tubular guard throughout its length or, if this was impracticable, by lose sleeving. Where a shaft is protected by distance fencing, the latter must be solidly bolted in position whence there should be no need to remove it.

The Government does not accept responsibility for statements from non-Official sources made in the advertisement pages of this publication, and the inclusion of any particular advertisement is no guarantee that the goods advertised therein have received official approval.



Trapped by Dragged Load (see page 11).



Meat Mincing Machines (see opposite page).



Explosion from Flexible Steam Pipe (see opposite page).



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ACCIDENTS

How they happen and HOW TO PREVENT THEM

Descriptions of Certain Accidents Notified to H.M. Inspectors of Factories

Published Quarterly
VOLUME 25 (NEW SERIES)
October, 1955

ISSUED BY THE FACTORY DEPARTMENT
MINISTRY OF LABOUR AND NATIONAL SERVICE
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LONDON: HER MAJESTY'S STATIONERY OFFICE

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FOREWORD

In this issue we refer at item 13, to wall collapses and mention the kinds of dirementances in which accidents due to this cause occur. As we go to press, information has been received of a further fatal accident in which a man was killed by the overturning of the gable wall of a Nissen but which was being demolithed. The sheeting and framework of the but had been removed leaving the gable end standing and one of the workmen was removing a frame from a window opening when the wall collapsed upon him.

This is the fifth final ascident which has occurred in the course of demolishing listen but in recent years, and in each case gable on walls had been left standing without any presentions being taken either to prevent their collapse or to prevent persons approaching. The case with which such structures are exceted and dismanded and the lightness of the construction may tend to defract from the need for caution, but there is no doubt that failure to appreciate property the risks involved can have the most serious consequences.

Correction

Index to Volumes 13 to 24 (issued with Volume 24, July, 1955), Page 4, Under "Collapse of Structures".

"Partial collapse of building .. 18 9"
Read

"Partial collapse of building .. 18 19"

INDUSTRIAL ACCIDENTS

VOLUME 25 (NEW SERIES)

The description of accidents and accompanying illustrations or diagrams in this publication are intended only for fature guidance in safety matters and not to covery implications as to the extent, if any, to which particular individuals or farms may have been to blame in connection with the accidents in question.

Gassing

IMPROPER USE OF TRICHLORETHYLENE

A storekeeper at an engineering works failed to return home one evening and a search was made for him in the factory. He was found lying over a board in a cloakroom, clutching some overalls; near him were a five gallon drum half fall of triblorestlyine and a small improveds debt nontaining more overalls as some of the solvent. From evidence given at the inquest it seems clear that the man, although knowing that unauthorised used forticohertlyine was forbidden, had stayed behind after working hours and chosen a quiet place where he could wash out some overalls.

In Volume 15, page 17, of this series attention was drawn to the ease with which trichlorethylene evaporates, giving size to dangerously high concentrations of vapour. The risk is enhanced by the fact that the smell of trichlorethylene is not unpleasant, and there is not the autural revulsion to working in it that there is with many other poisonous fumes. This incident emphasites that there is with many other poisonous fumes. This incident emphasites it to evaporate into the armoniest encliberediption is such as way as to allow

Railways

2. RUNAWAY WAGON

A heavy, main line, bogic wagon, weighing approximately 18 tons empty, was pulled into a works by one of the works' locomotives and left for a few days on an incline with a scotch under one of its front wheels and the brake applied to the rear bogic. The wagon contained steel girders to be used by a firm of contractors employed in the works, and it was agreed that any movement of the wagon should be made by the works' locomotive.



Whilst the contractor's men were unloading the girders, using a mobile crane, it was found that, due to the stowage of large cast iron pipes and materials alongside the wagon, the crane was unable to get into position to handle a long girder weighing about two tons, the last remaining to be unloaded. The contractor's men. therefore, decided to move the wagon about 20 ft. along the track and, having withdrawn the scotch and released the brake, arranged for the crane to give the wagon a push. The wagon moved. but on applying the brakes, it was found that it would not stop. Gathering speed, it jumped a 64 in. bolster some 100 ft. from where it started; after proceeding down gradients of 1:36 and 1:32, it collided with a stationary locomotive on a weighbridge about 300 yards further on, derailed the locomotive and knocked it into the weighbridge office, damaging the office so seriously that it had to be demolished. (See illustration). Inside the office were the locomotive driver and his shunter; most fortunately personal injuries were limited to bruising and shock.

First, It was a foolish thing to more an 18 rone wagen on an incline without a foomerive statehed. Scoonly, a dangerous and awtward positions are chosen for unloading with a crane or, convensely, there was an absence of good houseleeping. "in leaving the pipes where they were. Thirdly, no attempt seems to have been made to use sprags and soctobes judiciously during the movement of the wagen. Fourthly, although bresks fitted to wagens may be saintable for the inclines met with on main lines, they may not be suitable for the inclines met with on main lines, they may not be suitable for the inclines met with on main lines, they may not be suitable for the inclines met with on main lines, they may not be suitable for the inclines met with on main lines, they may not be suitable for the inclines met with on main lines, they may not be suitable for the inclines met with on main lines, they may not be suitable for the inclines met with the suitable for the previous suitabl

Lifting Tackle

3 SLING FOULED TRAILER

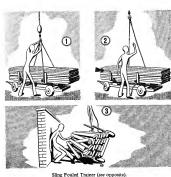
A load of timber planks was placed on a trailer by means of two one-leg wire rope slings, each of which passed under the load and had its two plain spliced loops on the crane hook. The trailer was such that the timber rested in a cradle so that, normally, the slings were free of the trailer.

The load la position, the nilege, who was standing in a surrow space between the trainer and stroke will, removed one loop of each sling from the crune and signalled to the crace driver to raise the book in order that the slings might be pulled clear of the load. Unfortunately, the slinger did not notice that the released end of one sling had fullen between the timber and a cradia arm and had become entangled. As the crace hook pulled upwards, the entangled diagneented an overturning moment on the trailer with the result that the timber field not bretapped slinger, sweeply joining his felt arm and lag (See Illustrations).

opposite).

Of course, the obvious lesson to be learnt from this occurrence is that it is wrong to signal to a crane driver to operate his crane until the signaller has made sure that the load or, in this case the silings, are free. Particular care is necessary when a load its lowered by a chain siling on to floor plates having slots in them, for there is a Bickinood of a link becomine it ammed in a skill.

Although the illustrations show that, quite rightly, packing pieces were placed in position to prevent damage to the sling ropes, they could with advantage have been larger, for it is bad practice to "nip" a rope: incidentally, this will cocur where the plain loops engage the crame hook. Aloo, no less than four loops were placed on this hook; lack of space on the hook is liable to lead to a loop becoming indevertently detached. A one-leg sling with a ring at one end to engage the crase hook and a hook at the other to be placed in the ring would institute this risk. Lardy, in this case there was no good reason for placing minimale this risk. Lardy, in this case there was no good reason for placing



ing I cuited Trainer (see opposite)

Electricity

4. FIRE AND EXPLOSION IN GARAGE INSPECTION PIT

A by of sixtem, employed as a garage hand at a small country garage, was instructed to clean of the grases and did from the wall of the shapestion print into the clean of the grases and did if the clean of the clean of the unto a shallow metal dids and set to work. He had instructions not to smoke or our lights, and to come up for air in the file vorecome by the funnes. He did in fact field drowny after he had desend about half the surface of the pit walls, and stood up on a box in the pit to got in head above ground level. The pit walls, and stood upon a box in the pit to got in head above ground level. The pit walls, and to the pit was a start of the pit was a start of the pit was a start of the pit was allowed to not one end of the pit, and which was slight. The wire guard was missing from the lamp, and as the bulb but the bottom of the pit it broke. The pitroler mixture in the pit innectablely burst into flances, and the boy was hadly There was evidence to show that the pit had been cleaned in the same manner, and with the handfamp in use, on previous occasions. The handfamp, being non-flameproof was, of course, entirely unsuitable for use in conditions so obviously liable to produce an inflammable and explosive atmosphere, and there were in fact other non-flameproof items of equipment in the pit. Hand-lamps of cortified flameproof types, or approved batterly handlamps, are available for use where explosive or inflammable atmospheres are liable to occur and should always be used. It would, however, have been greatly perfenshe to avoid the use of petrol altogether for such work, as the total risk was serious apart from the fire danger. 'Autous safe types of other greatly prefenshe to

5. LAMPHOLDER AS A COAT PEG

A labourer in a steel works, who was in the habit of hanging his coat on a disused batten-type lamphokler, was electrocuted when his finger accidentally touched the live exposed plunger-contact as he was removing his coat from the holder. The voltage to earth was 230 volts A.C.

The lampholder was fixed on top of a wooden plank some five feet above ground level and was connected in a motor circuit as a pilot lamp, but for some reason or other it had not been used for this purpose for some considerable time and it is more than likely that the man did not realise that the holder, which was mounted in an unusual position, facing upwards, was in fact connected to the sunolly.

This accident stresses the importance of disconnecting disused apparatus and wiring from the system.

6. FATAL SHOCK FROM LIGHT FITTING

A builder's labourer who had been working alone in the basement of a building under construction was found lying on the floor near an electric light fitting. Subsequent investigation showed that the man had been electrocuted. He had apparently taken hold of the metal shade to move the position of the light when he received a fatal shock (see illustration opposite).

The electric light fitting in question comprised a standard 14 ins. enumbled steel thade with procedual numboulder mounted on a rough timber stand and connected to the mains by means of a long length of two-core 31/020 tough rubber sheathed calls. No cart this was provided for bonding the steel shade to earth and it appeared that the supply cable had been damaged at the point of entity to the fitting, no proper calls entry or buth always been provided of entry to the fitting, no proper calls entry or buth always been provided such as this which had to be moved from place to place as worft grown and such as this which had to be moved from place to place as worft grown and the same of the supplement of the supplement of the live phase conductor being out and the steel shade being made alive by contact with this damaged

conductor.

In view of the onerous conditions generally to be found on building sites and the increased dangers of electric shock due to the damp and earthy conditions, it is advisable that such portable or transportable equipment should be operated at a reduced volume not exceeding 110.

Telphers

7. FALL FROM TELPHER

The driver of a telpher was fatally injured when he fell from a crab some 50 feet to the ground (see illustration opposite).

Investigation following the accident showed that the driver had ascended to a narrow platform above the driving eakin, persumably to assertain the cause of stoppage since the pick-up trolley was subsequently found to have slipped of the conductor wises. It is not known whether the dead man slipped or was lown from the inadequate platform by the strong wind prevailing at that time, but had there been said means of access and proper guards it is unlikely

that the accedent would nave occurred.

Although space is somewhat restricted on this type of equipment, the need for maintenance and adjustment of working parts should be borne in mind and seit means of access provided to all parts to which persons may have to go in with proper leading places and should extend sufficiently above the top leading position to provide accure handhold. Falforms should be of adequate width and be provided with handrails and toe boards. Care should be taken to see that all dangerous parts of machinery such as gear wheels, chains, sprockets, couplings, revolving shafts, etc., are securely fenced. It is advisable that maintenance work should only be carried out when power has been out off from the system and there is no liability of the telpher being set in motion whits a man is on the platform or studers. The need for maching he when white the platform of studers, and the platform of th

In the case of the machine involved in this accident, the need to approach tertolicy arms for replacements have been obvaited by refusing the trolley bracket at the opposite end of the bogie so that when the trolley slips off the wires it can readily be replaced by the driver from the chain floor level by means of a long non-conducting pole. A fenced platform has been provided external to the calculation that the this to be done and at the same time provide affections to the contract of the calculation of the contract of the contract of the calculation of the contract of the calculation of the contract of the calculation of the calc

Foundries

8. CRUSHED IN SHOT BLASTING CHAMBER

A fatal accident occurred in a shot blasting chamber, owing to the workpice on being firmly placed on a bogic. The chamber was 15 feet long, 10 feet wide and 7 feet high, and a cylinder weighing 24 tons which had a bulge office from the axis at one end had been shot blasted. The cylinder was pushed into the chamber resting on a bogic, and when in order to complete the shot blasting and the cantire turned over by a cancer. In this second to option the castine was and the cantire turned over by a cancer. In this second to option the castine was

unstable by itself since the bulk of its weight overhung the surface realing on the bogie and in consequence choics were used. These choics were not of the types intended for use with this cylinder but had been provided to keep pipes from rolling. Their base width was narrow and they were placed under the projecting portion of the cylinder on top of each other to make up the requisite height. After the bogie had been pumbed back into the shot blast chamber and shot blasting had been completed the packing of chocks collapsed and the easting fell from the bogie on to the shot blast operator.

It is important that the security of large and especially irregularly shaped articles should be carefully cheeded and supervision exercised to ensure that the appliances provided are being properly used. In this case the pipe chocks had been used on the three previous coassions when similar cylinders were being shot blasted instead of the set of chocks specially provided for these large castings.

9. FALL OF PLATES STACKED ON SAND

It might have been expected that foundrymen would have regarded a heap of dry sand as an unsuitable foundation for heavy objects. Apparently this is not always true and the point has been emphasized by a fatal accident. A pile of loose dry sand extended over an area which was roughly triangular

and about 20 feet across, the top of the pile being about 4 feet above the shap fool relved. Twenty or more cast iron plates, each weighing 44 toons, were stacked on the top of this beap of dry sand in two separate piles, about half of the plates being in each pile which rose to a height of about 10 feet. When piles started to move and one of the near twenty the piles that the piles started to move and one of the near was tilled by two of the plates which feel to a him.

Later investigation showed that the Works Safety Committee had complained about this method of storing plates but no action had been taken to stop the dangerous practice.

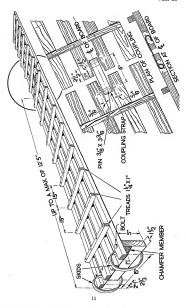
Building and Constructional Work

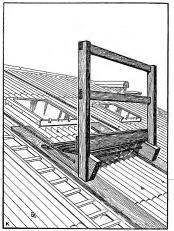
10. FRAGILE ROOF COVERINGS

A number of accidents, some fatal, have occurred in recent months due to falls through patent roof glazing and the circumstance suggest that there is still a failure in some quarters to appreciate the fragile nature of wired glass.

In most of these cases men have been at work on or near the glazing, or have been using either the glass or the glazing bars as a means of access to some other part of the roof, and in no case were duck ladders or crawling boards used or readily available.

Wired glass has low tensile strength and its resistance to fracture from even a light blow is very little different from that of unreinforced glass of the same thickness. The wire reinforcement embedded in the glass is only of light gauge, commonly 22 S.W.G., and its purpose is to hold the broken pieces of





glass together after fracture due to heat or a light blow. In no circumstances can wired glass roof coverings be expected to bear the unsupported weight of a man, and precautions have to be taken under Regulation 31(3) of the Building (Safety, Health and Welfaro) Regulations, 1948*, similar to those already advo-

cated in this Series for asbestos-cement covered roofs (see Volume 20, page 25.)

For providing secure foothold for roof work in general, but of particular value over fragile roof coverings, a roof crawling board of improved design

^{*} S.I. 1948, No. 1145-H.M. Stationery Office, price 1s. 3d.,

has been developed by the Institution of Industrial Safety Officers. Although strong and of reasonable width, beboard is light enough to be carried and handled easily by one man. In addition to its sound construction, details of which are aboven in the Illustration on page 11, special features of the crawfung board are the skids to facilitate movement of the board up the slope of tiled countries of the contribution of the state of the state of the state of the countries of the state of the countries of the state of the

Another device designed for roof work comprises a self-contained and easily movable working platform (see illustration on page 12). This affords the worker increased freedom of movement and is of considerable value where the platform of the platform is a self-contained which are set to the plieth of the roof on which the platform is to be used. The space between the boards and because the platform is sufficient to allow the passage of a standard size corrugated sheet. The platform is archored by proper which, platform corrugated sheet. The platform is archored by proper which platform the platform of the platform is archored by the platform of the platform of the platform of the platform is a self-contained by the platform may be supported from a valley gatter, if the gatter is sufficiently strong, or on ferrules attached to the roof sheeting boths.

11. COLLAPSE OF CEILING IN COLD STORAGE CHAMBER

One worker was killed and another injured when a ceiling in a cold storage warehouse collapsed. Altogether some \$\frac{1}{2}\$ tons of joists, boarding and slag wool insulation fell in a mass without any warning. The accident occurred in one of the ground floor cold storage chambers which was being de-frosted.

The ceiling bearers were softwood joists and the spaces between them were packed with sig wood. Above the joists was the concrete floor of an upper room while below was the ceiling which collapsed, comprising two layers of tongued and grooved boarding separated by a layer of strong paper. The plotted in the spaces between them were thus completely encosed and had been so for about forty wears since the building was crected.

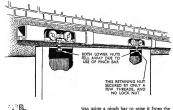
After the collapse it was found that the joints were blackmed along their whole length and that wet rot had decayed extensive areas. The slag wool insulation was very sodden and parts of the boarding had also been attacked by wet rot. Over the years water—most probably, condensate—had pencetared, into the eavities and, as there was no six creatation, the timber had gradually seed attacked to the control of the collapse of the collapse.

The joists had never been examined on account of the delibeuity of getting at them. The collapse, however, emphasises the importance of carrying out an examination of timber load bearing members which are enclosed. After the accident other storage chambers in the building were inspected and wet rot was found in most of the enclosed timbers. It should not be formetten that

even where there is no risk of water seepage, there may be a considerable risk of dry rot. This is always liable to occur when timber is enclosed and does not come in contact with circulating air. The difficulty of carrying out a sufficiently thorough examination of such ceilings would seem to jurisify reconstruction to allow ready access to the stress bearing members to enable periodic examinations to be carried out.

12. FALL OF SLIDING DOOR

A type of accident referred to in Volume 3, Page 20 of this Series was repeated when one of a pair of newly installed sliding doors fell upon and fatally injured a fitter. The accident occurred on a cold morning when water lodging in the ground guide channel had frozen. As the door would not slide freely the fitter





was using a pinch bar to raise it from the channel while his mate was pushing from the inside of the building. It was subsequently found that the ice was but a minor contributory factor in the accident.

The doors and their fittings were initially of good design and manufacture and had been in previous use on another building for a considerable time without incident. During a reconstruction programme it was decided to modify the doors for use in a new building and the factory occupiers undertook the modifications themselves without reference to the makers. There was no proper examination makers. There was no proper examination tractors or the occupiers, nor was there are you can be used to be a support of the contractors or the occupiers, nor was then are yoles supervision of the erection.

The construction of the door opening and the fixing of the listed proceeding simultaneously with the modification of the door and its fittings, and this resulted both in inaccurate dimensions and a poor fit, which caused frequent jumings. After the accident it was found that the two bolts which attached the door to its trolley were of different lengths, one being 1 inch shorter than the other. This resulted in the restaining nut of the shorter bolt being secured by only a few turns of the thread and in the absence of any lock nut. (See instanction.) After the collapse the two restaining nuts were found on the instanction of the contraction of the cont

Several other faults in construction were discovered and it was clear that the door had been modified and erected in a haphazard fashion. The fit of such door scalls for engineering skill and should be entrusted only to competent persons using the proper equipment. Sliding doors which require rough handling to move should always be suspect and the fault found and eliminated.

The correct method of supporting the door is shown inset in the illustration. An additional precaution would be to provide a retaining rail, as shown, to prevent the door falling.

13. WALL COLLAPSES

Collapses of wells occur all too frequently and many of the resulting accident are fatal. Although many occur while the wells, either alone or as part of a larger structure, are being demolibed, a surprising number occur during construction and, to a laser extent, in the counse of alterations to buildings. It to the obvious need for care in carrying out the work in order to ensure that other parts of the structure which depend on the particular wall for support are not weakened by the work of alteration. Nevertheless accidents do occur due to inadequate provision being made for preventing collapses while work in being done either on the wall itself or in its vicinity. This is particularly the appear at first sight to be unwarranted, and the taking of precentuals on any appear at first sight to be unwarranted.

An example of the latter kind concerns a simple excavation such as a trench adjacent to, asy, the wall of a small building or even a simple boundary wall. If the bottom of an excavation, however shallow, is at a lower level than the footings of an adjacent wall, either strutting of the exavation or shoring of the wall boundary that the structure of the example of the structure of the structure

Apart from this, walls can become unstable by pressure from the face of an executation or from accumulation of debris, and this may occur both in demolition and in the course of new construction. A wall which has not been disagred to resist brotzenal pressure should not have loose or other non self-supporting material placed against it unless it has been adequately stutted or otherwise supported on the opposite face. Cases have occurred where thin brick walls have been used as shuttering for concrete poured between them, and collapse has occurred when too much concrete has been poured

hefore allowing setting to take place. In other cases walls of underground duets which would ultimately be rendered resistant to side pressure from the soil by the hridging effect of the duet top have collapsed when hack filling was done prematurely.

Instability in new construction also arises from lack of care while brickwork is still " green ". Accidents have occurred due to men leaning on walls, especially thin partition walls, before the mortar has developed its full strength. The effect of wind on walls where the mortar has not had time to set has had serious results in very many cases, although it should he horne in mind that there have been several cases of collapses under wind pressure even after mortar has developed its full strength. Too rapid progress with an individual wall, which in the finished structure will depend on stanchions, cross walls, piers, or even ceiling or floor framing or eaves girders for resisting horizontal thrusts, may result in a serious collapse. Completion of some of the exterior walls of a building while one or more sides lie open, allowing wind pressure to be exerted on the interior of the building has been another cause of serious collapses. Where walls are liable to be subjected to pressures in excess of those for which they have been designed, precautionary measures should he taken by strutting. shoring, etc., to overcome any tendency to instability. Nor should the suction effect of wind be overlooked in the construction of a wall. A fatal accident occurred when the top portion of a gable-between caves level and the apexon the lee side of a building fell into one of the works roadways and killed a man. The lime mortar with which this wall was built had deteriorated and in addition, there was no connection between the wall and any of the roof members.

Cases also occur in which the overturning of a wall arises from methods of construction, decided upon without due consideration of the possible consequences, and as a result of circumstances arising which affect the course of the work. Delays in the delivery of materials may bring this about. For example, we have a substantial or the construction of the control of the course of

Collapses of walls during demolition mainly result from attempts to bring down as much as possible of a wall at one time. Mass demolition methods are invariably risky unless very special methods are adopted to ensure the safety of promonal. Many of the methods employed to demolith a wall en massive quite unicound, the intention being to make as great a length as possible ready quite unicound, the intention being to make as great a length as possible ready quite unicound, the intention being to make as great a length as possible ready quite unicound, the proposition of the prop

Even where a wall has been properly built in to a stable support such as the web of a stanchion or another wall at right angles, the bonding is often deliberately broken without any precautions being taken to support the wall temporarily during its period of tendency to instability. Should the wall have to resist any

appreciable wind pressure, collapse is inevitable. Men assisting to bring about a collapse under those circumstances are exposed to very great risk unless the work is done from a safe distance.

Wheever possible demolition should be carried out in the revene order to erection; brick and masonry walls should be demolithed a few courses at a time and where the condition of the wall is doubtful, temporary stores should be used to prevent premature collapse. Short cuts, such as arranging for the collapse of large areas of wall or floor, should only be undertaken under the direction of someone who is cognism of the risks involved, experienced in methods for preventing collapses and who has taken all practicable safety precurations beforehand.

14. TRAPPED ON BULLDOZER

An unusual accident on a petrol-paraffin engined bulldozer resulted in the driver receiving serious injuries.

The machine was in use on a building site and was started by the driver by a crank handle. This was done with petrol as fuel and when the engine had warmed up the fuel was changed to vaporizing oil.

After warming the ongine the driver switched over to oil fluel from the driving seat and then dismbed down to switch off the petrot supply at a foed cock near the carburettor. He climbed back onto one of the 16 ins. wide caterpillar tracks to regain his seat but in so doing accidentally depressed the clutch pedal. The machine had been left in gear and started to move rapidly in reverse with the unfortunate driver sitting on the right hand track.

The buildozer travelled about 50 yards before the driver's shouts brought ofter workers who were able to stop it. His legs bad become trapped between the track' and a bridge supporting the scraping attachment, the projectors on the moving track had severely lacerated his thighs. The bridge was not supported by the stop of the bridge was of such strong construction that it took the Fire

Brigade almost an hour to release him.

While the accident would not have happened had the machine not been left in gear it is evident from the circumstances that there were faults of design in the vehicle. A bandbold would have enabled the driver to gain his seat more easily while a positive safeguard with practical advantages would have been to place both fuel controls within reach of the driving rosition.

Woodworking Machinery

15. INADEQUATELY GUARDED "HOME MADE"

A woodworking firm requiring a small circular saw for trimming the ends of small section stock as it came off the straight line edging machine, decided to make up one for themselves using one spindle of a double headed horizontal drum sanding machine. The bench had a metal framework and a plywood table and a saw blade 9] ins. in diameter was mounted on the spindle. The hilded projected | lins. above the table and a shelf was fixed between the corner supports just below the lowest point of the blade. The top side member of the frame work was 3½ ins. deep and a board of 2½ ins. wide was fixed to the top of the shelf, thus leaving a gap 2 ins. deep alongside the saw blade through which access to the underbench part of the saw could easily be obtained.

The operator decided to clear out some of the sawdust which had accumulated on the shelf and, after pressing the "stop" push-button switch, put his hand through the gap at the side of the saw. Three fingers and the thumb of his left hand were amputated when they came into contact with the saw.

In the construction of this saw bench no regard was paid to the requirements of the Woodworking Regulations* in respect of the guarding of the part of the saw blade below the bench table. The guarding required is prescribed in the following terms:—

"two plates of metal or other suitable material, one on each side of the saw, such plates shall not be more than six inches apart and shall citted from the axis of the saw outwards to a distance of not less than two inches beyond the teeth of the saw. Metal plates, if not beaded, shall be of a thickness at least equal to 14 gauge or, if beaded, be of a thickness at least equal to 20 gauge."

The gauge referred to is the Imperial Standard Wire Gauge.

The regulations permit the use of other safeguards provided they render the machine equally safe as it would he if guarded in the manner prescribed.

The prescribed guarding caters for two important aspects neither of which was dealt with in the construction of the "home made" bench. First the metal plates are specifically intended to prevent accidents similar to the one described and there is no doubt that if the machine had been guarded in this way, this accident would not have happened. Secondly, the gap which is permitted between the two plates is adoly for the purpose of allowing the saw-permitted between the two plates is adoly for the purpose of allowing the saw-when the sawdust is removed. The shelf which was fitted below the saw blade forced the sawdust to longs and build up round the blad who with the saw blade forced the sawdust to longs and build up round the blad.

Another aspect of this "home made" construction which, although it had no bearing on the particular acidient, might well have led so others in the cutting point, was the slow speed at which the blade was being worked. The shaft on which the saw was moutine revolved at 1.500 r. m. which produced a rim speed of 3.750 ft./min. compared with the normal rim speed for circular saves of 10,000 ft./min. The cutting efficiency of the hlade was bound to be seriously impaired and the resulting tendency to chop and snatch at the wood was very liable to onrowlee acidients.

^{*} S.R. & O. 1922, No. 1196.-H.M. Stationery Office, price 3d.

16. DANGEROUS USE OF OVERHAND PLANING MACHINE

An experienced joince was using an overhand planning machine to cut a rebate $j_1 n, i_2 j_1 n$, in the edge of a board $i_1 n$, thick, $i_1 n$ in, wide and $12 f_1$, long. For this purpose be set the front table j in, lower than the back table and set the fence j j_1 . Note that end of the cutter block. When he had aimset finished and fourth fingers were badly cut and his little finger had to be amputated at the second joint. Work of this nature cannot be done safely on an overhand planing machine and the risk is increased when the workpiece is very long as in this case. The workpiece had to run along a strip of the table only $j_1 n$ in wide which was much too narrow to ensure subility and the risk of the workpiece had to be a subject of the subject of

Work of this nature can be done with the minimum of risk on a vertical spindle moulding machine. The table of the machine will provide an adequate bearing surface and a "Shaw" guard, with pressure pads of suitable width for the section of the workpiece, will, in conjunction with the table and fences, form a order of the section of the workpiece, will, in conjunction with the table and fences, form a provided of the section of the workpiece, will be a section of the workpiece, the section of the workpiece of the correct position relative to the cutters.

17. CLEANING OF GLUEING MACHINE ROLLS

Giue spreading machines are widely used in the manufacture of plywood and in those branches of the woodworking industry in which laminated forms are built up by glueing their surfaces together. These machines bave wide rolls which pick up the required amount of glue from reservoirs or glue ducks and transfer it to the surfaces of the parts to be joined as they are passed between the rolls.

The rolls must be cleaned frequently to prevent a build up of glue which would spoil the work and this may bave to be done in the course of a production run. If the glue is allowed to barden it is very difficult to remove.

A youth attempted to remove adherent give from the upper roll of a give spreading machine by running a chief along the roll on its invanzing side whilst the machine was in motion. The chief slipped and his band entered the gin, the property of the roll of the relation of the roll of the roll of the roll of the only statistical learned to the roll of the machine of the roll with the chief in consisting of a rod carried on branckets at each side of the machine. A chief in contact with the roll with the object of preventing the operator's hands approachled the roll of washed of with an adequate supply of water before it sets hard and cannot be recommended since, in addition to the possibility of the rolls being damaged, counts of the fingers with the roll and the chief would almost certainly inflict counts of the fingers with the roll and the chief would almost certainly inflict entered which climinates any reed for the roll of the rolls before the rolls are its and the state of the rolls are its and by band, care about the taken that it is always done on the out-running side with the rolls set apart to the maximum extent and that loose material is not used which can catch up on a roll.

Section 20 of the Factories Act, 1937, prohibits women and young persons under 18 from cleaning any part of a machine if such cleaning would expose them 10 risk of injury by any moving part either of that machine or any adjacent machinery.

Rubber Machinery

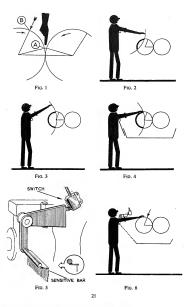
18. SAFE WORKING ON HORIZONTAL TWO-ROLL MILLS

Horizontal two-roll mills are in everyday use for the manufacture of rubber and similar plastic materials and many serious accidents have occurred at the nip between the rolls. For many years the best known method of guarding was a single horizontal distance but are about closs the light in front of the makine and a trip wire or rod within easy reach. The object was that the but would entate him to stop to method the be in difficulty, the trip wire would enable him to stop to method the best in difficulty, the trip wire would enable him to stop to method the best of the fine of the control of the stop with the stop to the stop with the stop wit

An analysis of the accidents showed that the most common cause was entanglement of the hand of the operator in the material, resulting in the hand being drawn into the nip, the entanglement in some cases being so relentless as to pull or stretch the operator over or under the distance bar with such force that injury was caused by the bar itself. It was found also that the first reaction of an operator in difficulty was not to operate the trip device but to attempt to extricate his hand from the material and thus get away from the machine. In some cases the operator used his free hand to try and liberate the other, resulting in both hands being caught. It was obvious also that an operator could not be relied upon to use emergency trip gear when in difficulty and in those few cases when any attempt was made to do so, it was too late to prevent injury. The following description of a system of safe working on two-roll mills is necessarily brief and the interested reader is advised to refer for detailed information to the Report of the National Joint Industrial Council for the Rubber Manufacturing Industry on "Safe Working on Horizontal Two-Roll Mille " *

When a finger moves towards the intake between a pair of rolls as in Fig. 1 on opposite page, trapping is presumed to occur first at a point M^{-1} when the horizontal distance between the rolls is $\frac{1}{2}$ in. If the rolls can be brought to rest by means of a brack in a distance AB, B is then the latest point at which the brack must be applied to prevent a hand outpit in the material being carried round anti injured at M^{-1} . But herefore it the "NaFFTY LIMIT" and the point beyond which no person who works at the machine should be allowed

Published by the National Joint Industrial Council for the Rubber Manufacturing Industry, 236-237 Royal Exchange, Cross Street, Manchester.



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By raising the rolls from their usual setting (Fig. 2) to a higher position (Fig. 3) it is possible to locate a bar so that it will prevent the operator reaching beyond the SAFETY LIMIT and at the same time allow him access over the bar to a greater area of roll surface in order to manipulate the material on the rolls either by hand or with simple tools. If the space between bar and tray is filled in as shown in Fig. 4, the operator is prevented from reaching under the bar. If the bar is arranged so as to be sensitive to pressure applied horizontally in the direction of the rolls, any force in excess of normal exerted by the operator's body can be utilised to operate a switch which cuts off the power and applies the brake (Fig. 5). To avoid inadvertent stoppages in the ordinary course of working it is sufficient to load the bar so that it resists a horizontal force of about 40 lbs., and this will not prevent the bar being moved easily to trip the switch and apply to brake when, as a result of his hand being caught and nulled by the material, the pressure from the operator's body exceeds that amount, Fig. 6 shows the combination of raised rolls, sensitive safety bar and fixed guard between bar and tray.

The essentials for safe working on horizontal two-roll mills are:-

- (1) An efficient brake must be provided so that the position of the safety limit can be established.
- (2) A sensitive safety bar must be provided.
- (3) The space between bar and machine tray must be filled in to prevent access except over the bar.
- (4) The sensitive bar must be positioned so as to prevent any worker employed on the machine reaching beyond the SAFETY LIMIT. This may involve, in the case of most existing installations, increasing the height of the machine relative to the worker.

Since the speeds and diameters of the front and back rolls may differ, the positions of the SAFETY LIMIT and of the sensitive safety bar must be determined separately for each roll.

In a future volume of this series some practical applications of sensitive bar guards will be described and illustrated.

Fires

19. UNCONTROLLED HEATING OF CELLULOID

When used in industry celluloid sometimes has to be heated to make it soft enough for process requirements. Such heating should always be under strict control in order to ensure that the material does not attain a sufficiently high temperature to promote rapid decomposition, otherwise it is liable to ignite snontaneously with disastrous results.

In a single-storey factory employing seven persons, sheets of celluloid 2 ft. 6 ins. long, 6 ins. wide and 3/16 ins. thick had to be softened so that they could be cut into strips by rotary knives. The sheets were heated on shelve in an oven having an open front, the heating medium being a 1,000 watt electric

hot plate standing on the bottom of the oven and separated from the shelves by a metal plate. The only control of the oven temperature was the manual switch for the hot plate, and no thermometer was provided to indicate the temperature in the oven. The man employed on cutting the celliboid put a control of the control o

As invariably happens in the case of a celluloid fire all positive evidence of the cause was destroyed, but the known circumstances are sufficient to explain it. Although the oven had an open front, in the absence of another outlet here would be little air circulation. The temperature which could be attained at the closed end was indeterminate, but it certainly would be much greater than 300°T—the temperature at which celluloid decomposes rapidly. The products of thermal decomposition consist of highly inflammable gases which, a published contended from it all the crops the. Decomposition is accompanied to the contended of the

When work was restarted after the first the heating arrangements were changed and the sheets were softened in an open tank of hot water. A temperature somewhat below boiling point was found to soften the celluloid adequately and this method ensures that an upper limit of 2127—the boiling point of water cannot be exceeded. This is to far below the critical temperature for decomposition that it can be used without risk. If celluloid must be heated and if for the control of the best above to ensure that the temperature is succentically controlled and that the effectiveness of the control be checked frequently.

In the case in point, probably due to the ignition of the gases, the fire pyrind to rapidly to be controlled. More calluloid fires, however, start with the ignition of the solid material and can be checked by dowing with water. Test have shown that water in quantity is the most efficient extragisther for a celluloid fire. A high pressure jet is not necessary, and in the case of a fire occurring in fingly divided material, it may be detrimental since it may scenter the burst pringing fragments. Extinguishers which rely for their effect on their ability to exclude aff from the fire are unless since efficient convenient comparison.

Machine Tools

20. CRUSHED BY HORIZONTAL MILLING MACHINE

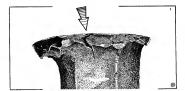
Two boys were working at a horizontal milling machine; the boy who was in charge wished to view the set-up of the job and instructed his companion to traverse the table so as to bring the work clear of the cutter guards. This was done by engaging the power traverse mechanism. The boy in charge, being intent on looking at the work, failed to realise that he was in a position where the end of the table as it approached the end of its traverse would come close to the adjacent well. He was trapped and received adhominal injuries close it is clear that such an accident might very well have been fatal. (See illustration opposite). It appeared that this machine was rarely used for work which would involve traversing to such an extent as to reduce the gap between the table and the wall to less than it is in. and in consequence the danger arising from a full traverse had not been realised. Following the accident, the machine was turned through 50° so as to climinate this danger.

Hand Tools

21. HEAT TREATMENT OF TOOLS

Heat treatment of metals calls for experience and skill coupled with careful control at each stage of the operation. Risks of two different kinds which may result from haphazard methods are illustrated by the following accidents.

In one case a fragment from the head of a chief in use was projected as volently as to piecre the thigh of a workman passing by. The fragment was of early embedded that several operations were performed in an attempt to remove it. The liberation below shows the head of the chief; it is thought that the fragment in the form of a sliver flew from the crevice indicated by the arrow. In the same time a piece of the hardened point of another chief also broke away but fortunately without injuring anyone. Investigation showed that it had been the practice for workmen to make and heat treat their own chiefs. The heat treatment was not effectively controlled and in consequence brittle conditions were produced.



In another case an electrician, who had to cut a number of holes in brickwork, decided to make a cutting tool from a length of electrical conduit. He serrated one end with a file and then decided that it would be better to harden the end

of the tool. To do this he heated it and then dipped the white hot end into a tin of hardening powder. When he quenched the tool in a bucket of cold water, steam, water and powder were blown violently up the tube into his face causing severe scales (see illustration opposite).

It should be part of a works organisation to see that proper tools are provided and used. It is also important that all hand tools are maintained in good condition. This can be achieved by a system of routine examinations leading to repair or replacement and by instruction of workpeople in the care of tools issued to them.

The danger of defective hand tools was dealt with in Vol. 17 of this series (page 12).

Explosions

22. EXPLOSION FROM A VESSEL CONTAINING CEMENT

A fatal accident occurred when a vessel, originally devised for paint spraying, exploded violently while cement grout was being forced from it by compressed air for the purpose of filling the prestressed cable channels in a concrete beam.

The vessel, manufactured about 23 years ago, was intended for use at a working pressure of 30 lbs, per square inch, but the exantlings and construction were such as would not satisfy present standards. While the vessel as supplied was infeated with a presenter gauge and provision made for a reducing waive, no safety valve was provided, so that Section 31 of the Factories Act, 1937 would not have been satisfied that the apparatus been used for paint syraring as at first the provision of the prov

Occupiers or contractors having vessels of dubious age and strength would be well advised to discontinue their use for containing compressed air at any pressure. It may be that the use of such equipment may be occasional only and their is, therefore, the strong possibility of its high about in odd corners of factories or building sites and being overdood, except when an unexpected it is entirely unstable.

23. BURSTING OF OXYGEN GAUGE ON BREATHING

During the routine examination of a self-contained oxygen breathing apparatus, the contents of the oxygen brute were used up; the emply bottle was replaced by a bottle charged to 120 atmospheres. When the control valve was opened, the pressure gauge exploided, blowing fragments of glass into the face of the worker who was examining the apparatus. Fortunately at the critical moment between the control valve of the control valv

Spontaneous combustion in high pressure oxygen of a trace of grease in a pressure gauge has on a number of occasions caused the explosion of industrial oxygen apparatus. This was not thought to be the cause in this case, nor in similar incidents involving the oxygen breathing apparatus belonging to the fire brigades of some local authorities. The matter has been investigated by the Home Office (Fire Service Department) and the Joint Fire Research Organisation, in consultation with the makers of the breathing apparatus. It was found that with one type of set, even when the cylinder valve was opened slowly. the temperature caused by adiabatic compression of the oxygen could exceed the ignition temperature of the washers in the connections of the pressure gauge and reducing valve. Although it is not known positively that the combustible washers initiated the explosions, the washers were found to have been reduced to ash and certainly contributed to the explosions. Combustible washers should therefore be excluded from the high pressure lines; in their place should be used special metal washers now obtainable from the makers of the apparatus. In the modern pressure gauge, the Bourdon tube is protected by a bulkhead plate, the pointer spindle working through a hole in the plate. With this type of gauge the operator is much less likely to be injured if a Bourdon tube should burst

24. UNAUTHORISED USE OF ACETYLENE

The foreman of a large neat rolling mill noticed that bees were entering their neat through a grating in a cavity wall of the factors. In order to destroy the bees he used some welding conjurment to fill the cavity with acctylene gas. He then applied the lighted welding torch to the grating. There was an immediate explosion which buried him to the ground, blew out the cavity wall and parhapse completed the destruction of the best rections of the source.

This is another example of an accident following the misuse of apparatus. Fortunately the man was not seriously injured, but he might have been the cause of severe injuries to other people.

Process Machinery

25. RISKS WHEN RELEASING COMPRESSED SPRING MATTRESS INTERIORS

It is becoming customary for the interior springing of mattrease, etc., to be delivered to the users by the spring makers in an assembled condition. In their normal state these assemblies are extremely bully and hence are costly to transport and occury a considerable amount of storage panee. To overcome these difficulties, statels of about disconsistent of the condition of the contract of the condition of the c

Ropes have been placed round the packages tied with running knots so that they can be released more or less gradually after the steel banding has been cut. Apart from the difficulty of paying out the ropes so that they run easily yet slowly to release the pressure, they must be of good quality and of adequate size, otherwise they are likely to be broken when the steel banding is cut, especially if one is taking a greater share of the load than the others.

One method which had been suggested involved backing a motor vehicle against a package of compressed springs, with the intention that after the bands had been cut the necessary gradual release would be obtained by releasing the brake and allowing the springs to move the vehicle forward.

A third method necessitated the use of five men standing, one in the centre and one on each occur of a compensacy pactage in the loop that they would be able to nextrain the crystation when the bands were cut. When this was retried out, however, the sudden expansion of the springs caused all five to be larted on the observate, the sudden expansion of the springs caused all five to be larted and to the air, fortunately without serious result since, quite fortuitously, which were standing nearly. The consequences might, however, have been very serious and own fatal.

The release of these compressed packages should not be undertaken by means which are haphazard. Any method used must enable effective control to be maintained throughout the operation. Specially designed machines are available which make it possible for the pressure to be released gradually and the work done without risk.

26 TORRER PULLING MACHINES

Fig. 1 below shows a typical toffee pulling machine in common use in the larger sweet making factories. Two arms rotate about a fixed arm, the effect

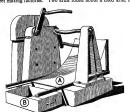
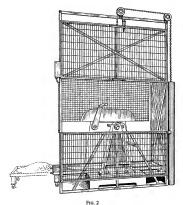


Fig. 1 27



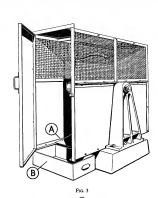
being to pull the toffice in order to serate it and change its structure. The toffic is deposited on to the arms in a batch weighing some 50-100 hs. and then supbe done either with the arms at rest or in slow motion. At the end of pulling, the contract of the contract of the contract of the contract of the contract some cases, the office may fall off the arms during the early stage of pulling and the machine has then to be stopped and the toffice reloaded. Serious accidents occur from time to time due to a worker coming into contact with the arms when in motion. In one recent case a man received final injuries when he was tracked on the beat of the nextly born of the arms as he bent down when he was tracked on the beat of the nextly born of the arms as he bent down

to pick up the toffee.

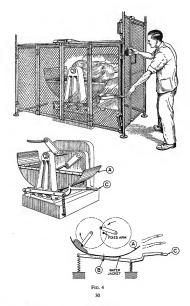
Accidents through contact with the revolving arms can be prevented by fitting an enclosure round the machine as a whole, and Fig. 2 above shows an example of an enclosure with a suitably counterbalanced frontal access rate

interlocked electrically with the drive. The enclosure is of sufficient height to prevent the pulling arms heing reached by a person standing on the floor, but the top is open to permit the sprinkling of the powder ingredients whilst he arms are in motion. With the gate in the open position as shown, the toffeen may be readily loaded or the machine cleaned. Upon completion of pulling, the mashine is stopped, the gate opened and the toffee stripped from tray in the pulled out of the machine (as shown dorted) to enable the toffee to be readily plotded or the machine (as shown dorted) to enable the toffee to be readily plotded.

Fig. 3 below illustrates a machine fitted with an enclosure having an access door, electrically interclocked, at one end. The hash of offee is fed in to the moving arms by dropping it through an opening in the top of the enclosure. A low platform (not shown) alongside the machine should be provided to facilitate this. Should the toffee miss the arms when dropped or otherwise fall of the control of delivered in the text B which can be withdrawn and the toffer re-loaded.



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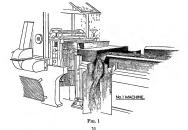
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The consistency of the toffee may in some cases be such that it tends to fall away from the arms frequently during the initial stages of pulling. To occuone this difficulty, one user has developed a device which enables the toffee to be fed back on to the arms mechanically. A curved may a first data shown in Fig. 4 opposite. This is made to swivel about an axis B by means of a handle C, so enabling either end of the tury to be raised until the toffee is squeezed between one of the arms and the curved tray, which results in the toffee students of the term and so being reloaded. The tray is partially water cooled to the control of the control of

27. DANGEROUS INTAKES AT FEED ROLLERS OF HACKLING MACHINES

Hackling machines or goods spreaders are widely used in the rope and other coarse fibre industries for the initial preparation processes for sisal, hemp and similar fibres.

The machines essentially comprise two conveyor beits set one behind the other along the length of the machine and eash carriage hackle principle backets and the length of the machine and eash carriage hackle principle second belt running faster than the first to produce the combing action by means of which the fibers are driven out and high parallel to one another. The fibres are fed to the first hackles by fitted fed rollers, and serious sculdents have cocurred at the intake when the operator has been entering the materials between those rolls. The machines are usually run in a series of four, numbered 1 to 4 researchedy.



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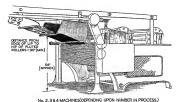


Fig. 2

Number I machine is usually provided with a conveyor band or lattice on which the material is planed to be carried to the feed rolless. It is estemanty however for a side entry point to be provided mear the feed rolls for the intermediate the provided mean the side of the provided mean the side of the side machine is fed directly to the succeeding machine over a creed, but if the sliver breaks it has to be entered into the feed rolls at the start of a length. This is more likely to occur at Number? machine, speachful If poor quality short fiftee is being worlded, since at this point the silver is relatively weak. Apart from dangerous if they are accessible, and should be securely rescond. Although the Number 1 machines are field by a conveyor band, accoss to the rolls is often possible at the deless of the conveyor.

A suitable guard for machines which include a conveyor feed band is shown in Fig. 1. It consists of a tunnel long enough to prevent a person reaching the roller nip and provided with a hopper-like opening to enable lubricant to drip on to the fibres. Side screens prevent access to the intake between the machine and the conveyor framework.

Fig. 2 illustrates a guard suitable for machines which are fed directly from the delivery of the previous machine. In this case access to the fluted rollers is prevented by a hopper guard, the lower edge of which is approximately at shoulder height and at a sufficient distance from the roller nip to prevent a person reaching the roller integration.

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Crushed by Horizontal Milling Machine (see opposite page).



ACCIDENTS

How they happen and HOW TO PREVENT THEM

Descriptions of Certain Accidents Notified to H.M. Inspectors of Factories

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Rotary offset litho machine-nip Traps at letterpress printing	23 18	1 26	SCAFFOLDING—see BUILDING WORK. SCRAP DISPOSAL.		
machines. Traps at letterpress printing	21	23	Dangers during dismantling	19	26
Bookbinding. Guarding of cloth cutting machines	16	5	Cluster lights on cranes Displacement of loose article Failure of cargo block	18 14 23	19 7 7
PROJECTING SPINDLE ENDS, ETC.			Fumes from oxy-acetylene burners Inadequate lighting at quay Maintenance of winches	23 18 22	18 19 24
Entanglement with clothing Projecting bolt on boring bar PROTECTIVE CLOTHING.	23	24 24	Mooring rope fouled by propeller Overturning of painter's raft Prefabrication, manoeuvring by	16 16	8
Fire in tube works Goggles, at small air-driven grinders	16 21	23	Cranes Slinging of plates Slinging of plates	14 19 19	7 1 2
Goggles prevent serious eye injury Safety boots Safety bats	20 22 15	7 25 17	Struck by Radar scanner Supervision of young persons Trapped by winch	16 14 22	8 6 24
PUTLOGS - see BUILDING WORK.			SHUTTERING — see BUILDING WORK.		
		1	0		

	NO.	NO.		NOL.	NO.
SIGNALLING.	-	-	STOPPING AND/OR STARTING		
Crane jib fouls obstruction	23	26	APPLIANCES—continued.		
Sack elevator	13	7	Housing of push-buttons	13	10
Sack elevator	19	15	Mixing machines	16	-4
Sack hoist	23	11	Obstructed by clothing	13	24
Trapped in endless rope sling	18	10	Pendant much-button control	24	6
SLING CHAINS-see LIFTING			"Stop and lock " buttons	19	16
TACKLE			Work inside machines	19	16
			STORAGE BUNKERS AND STORAGE RACKS.		
SPINDLE MOULDING MACH- INES — me WOODWORKING			STORAGE RACKS.		
MACHINERY.			Collapse of hopper bottom	17	25 21
			Construction	16	
STACKING OF TIMBER—see also			Construction	17	25
STOWING OF LOADS.			Construction	20	5
Stowage—indiscriminate	24	8		22	18
STEAM HAMMERS.				20	5
Unsafe method of working	20	18	Gravel bin, fetality in	22	18
STEAM PLANT.			Grain silo, gassing in	20	40
Adaptation by inexperienced			Overturning due to overloading	16	21
person	15	8	Vibrators, use of	22	18
Adaptation by inexperienced	-		STORAGE TANKS.	-	
person	21	16	Corrosion, failure due to	23	9
Blow down pipe, explosion	23	21	STOWING OF LOADS.	-	-
Blow down pipe, faulty fitting	23	21		22	19
Blow down pipe, porous metal	23 22	21		24	19
Cold weather precautions	13	12	SUPERVISION.		
Condensate, collection of Condensate, collection of	17	13	Abrasive wheels, mounting of	20	20
Condensate drainage	13	3	Blasting operations	19	13
Food water supply failure	13	2		23	17
Feed water supply failure	21	27	Demolition work	16	16
Firebox crown plate failure	13	4	Fork truck, improper use	23	22
Fittings, maintenance of	13	1	Hydraulic jack-improper use	21	10
Fittings, maintenance of	17	13	Lathe, out of balance work	22	21
Flexible pipe couplings	24	18	Lifting operations	19	2
Hot water tank explosion	22	12	Storage racks, erection of	16	21
Joint failure due to waterhammer Lancashire boiler, explosion	17 23	13 20	Stowing operations	22	19
Pipe, pressure in blanked-off	23	20	Structural work	14	11
portion otalikeu-on	18	18	Unloading timber	24	13
Pressure cooker " adapted "	15	8	Young persons at meat mincing machines	24	7
Pressure cooker explosion	17	15	Young persons on ships	14	6
Pressure cooker—over pressure	17	15		4.4	0
Safety valve, defective	21	26	SWITCHES. Improper use of limit switch	17	1
Safety valve, explosion	21	26		17	
Ship's boiler scaling	16	8	TANKS.		
Steam pipes, disused	18	18	Entry into	14	.1
Steam tube oven, explosion	17	14	Fall through fragile covering	15	11
Stop valve, defective	22 13	12	Under repair, danger of applying	15	2
Thermostat defective	17	14	heat	13	2
Tubes, overheating	13	1	TESTING—see also EXAMINA-		
Tubes overheating	13	â	TION OF MACHINERY AND		
Tubes, overheating Vertical boiler, explosion	17	14	PLANT.		
Vertical boiler, explosion	13	4	Before entry into confined space	18 14	11
Water circulation inefficient	13	2	Danger of compressed air	23	13
Waterhammer, explosion due to	13	_3	Reinforcing materials Trip guards at platen machines	23	13
Water level, checking of	23	20		23	
Water tube boiler, explosion Water tube boiler, explosion	13	27	TEXTILE MACHINERY.		
	21	27	Woolcombing mill, incomplete		
STOCK BARS see LATHES			guards	23	10
(MACHINE TOOLS).			THOUGHTLESS ACTION.		
STOPPING AND/OR STARTING			Drum dropped on fellow work-		
APPLIANCES.			man	23	4
Circular saws, etc.	18	.2	TIMBER.		
Distinctive markings	15	24	Unloading of	24	8
			11		

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	VOI NO			NO.	NO.
TRACTORS.			WELDING.	NU	NUL
Used for felling trees	24	23	Cable cut by drum	18	8
			Danger from inflammable residues	15	2
TRAINING OF YOUNG PER-			Explosion of scaled pine	13	20
SONS, ETC. Meat mincing machines	24	7	Purging of acetylene blow pipes	20	4
	13	24	WINCHES.		
Platen printing machines Platen printing machines	23	-71		24	22
Ships	14	6	Securing of wedges	24	22
					44
TRANSMISSION MACHINERY.		_	WOODWORKING MACHINERY.		
Belt mounting Gearwheels at live roll conveyor,	13	8	Adaptations of machines	21	12
Gestwices at the foll conveyor,	13	9	Adaptations of machines	23 21	27
exposed	13	9	Guard maintenance	20	11
	24	13	Portable machines.	21	11
Gearwheels under floor plates-			Guards, secure fixing Portable machines. Rebating tools Unsuitable machines used	21	12
exposed	17	17	Unsuitable machines used	18	î
Overspeeding	21	13	Unsuitable machines used	21	12
Pulley, burst cast fron	21	13	Unsuitable machines used	24	1
Pulley, loose, seized on shaft	17	27	Unsuitable machines used	24	2
Running tests	24	13 27	Band Mills.		
Shafting in motion—approach	13	- R	Approach to blades	15	4
Shafting in motion—approach	21	17	Careless operation	15	4
Shafting in motion—approach Spindles, cable drum—exposed	15	25	Defective feed roller gear	19	12
			Boring Machines.		
TRANSPORT—see also MECH- ANICAL HANDLING.			Use of mild steel bit	15	3
	21	10	Circular Saws.		,
	22	6			10
Faulty loading of wagon	22	19	Dangerous approach	16 18	10
Fork truck, tran between meet				22	23
and steering wheel	21	9	"Dropping on "dangers	18	ĭ
	23	22	"Dropping on "dangers	24	î
In machine shops	13	25		18	1
Railway wagons-means of access	21	8	Improper use Improper use Irregular table surfaces	22	23
Wheels blown off lorry	24	9	Improper use	24	1
TRAPS AGAINST FIXTURES.			Pregular table surfaces	17	16 23
Between structure and movine			Riving knife, absence of Spindle nuts, hand plates	17	16
ladder	19	18	Wood thrown back	18	1
TRICHLORETHYLENE.			Wood thrown back	24	î
Cleaning of small articles	15	4	Conveyors,		
Gassing risks	15	14	Drum sanding machine	16	11
Open containers	15	14	Guarding insufficient	16	11
TUBE BULGING AND REDUCING			Straight line edger	16	îî
MACHINES,			Unsecured guards	20	1
Clamping bars	18	4	Sanding Machines,		
TUNNELLING.	10	-	Fracture of sanding disc	23	27
	13	17			
	13	11	Spindle Moulders. Flying cutters		
TYRES. Inflation from air line				14	16 16
mation from air and	21	15	Packing cutters	14	16
UNSUITABLE WORK FOR			Securing of cutters	14	16
MACHINES.				-	
Circular saw	21	12	Wood Turning Lathes. Dangerous adaptation	23	27
Circular saw	24	1		23	21
" Drunken " saw	18	1	WORKS OF ENGINEERING		
WARNING NOTICES.			CONSTRUCTION.		
	18	6	Dolly blown from pile helmet	15	17
Inflammable residues	15	2	Heat generated in pile helmet	15	17
Misunderstanding causes accident	19	16	Misfires during blasting opera- tions	13	17
Plating vat, dangers	15	13		13	1/
Roof materials, fragile	20	22	X-RAY BURNS.		
Work inside machines	19	16	Protection for operators	20	6
			12		
			**		
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